

6.4

7

GROUP #: 1A
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

One action causes an equal reaction to occur.

2. Negative feedback:

One action causes the opposite reaction to occur.

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

The more cloud cover there is, the less energy from the sun is allowed to be absorbed by the Earth's surface. This causes for an overall cooler climate.

B. Which specific step makes this a negative feedback loop?

The increased amount of cloud cover causes more energy reflected and a cooler climate --- more clouds, cooler climate.

C. How might cloud cover produce a positive feedback?

Water vapor itself is a greenhouse gas which traps and retains heat. The more cloud cover to trap heat, the warmer the climate.

Albedo:

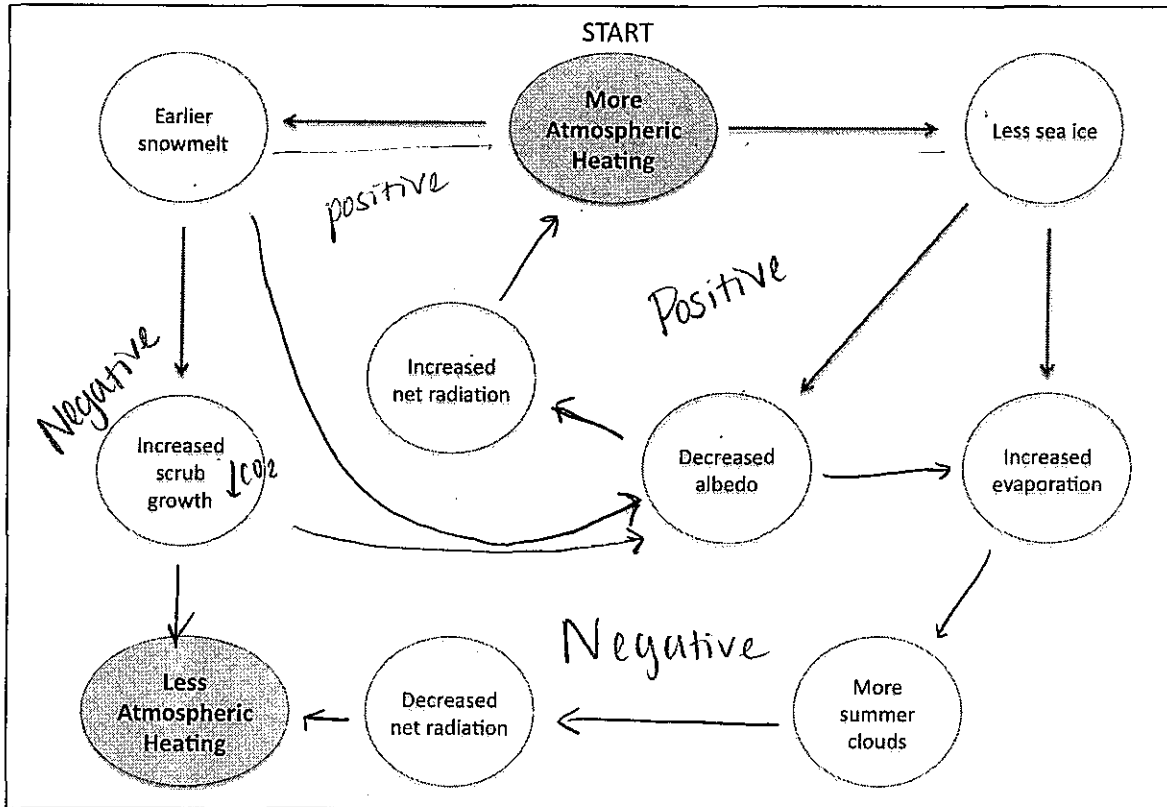
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This would be a positive feedback loop. This is because the less glaciers and ice sheets, the less is a smaller amount of the sun's energy that is reflected and a higher amount of the sun's energy that is absorbed by the Earth's surface which causes a higher amount of heat re-radiated which means a warmer atmosphere which would then cause more glaciers and ice caps to melt.

ISP203A – Global Change
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

As a result of more atmospheric heating there is an earlier snowmelt which increases scrub growth. The more scrub growth there is, the more CO_2 is absorbed in during photosynthesis which causes for a decreased rate of greenhouse gases which causes for a cooler atmosphere. A cool atmosphere counteracts the warm atmosphere to reach equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

The less sea ice causes decreased albedo which allows for more energy from the sun to be absorbed by the Earth's surface which causes more atmospheric heating. The more times around the loop, the hotter the atmosphere becomes.

ISP203A – Global Change Feedback Loops

Objectives

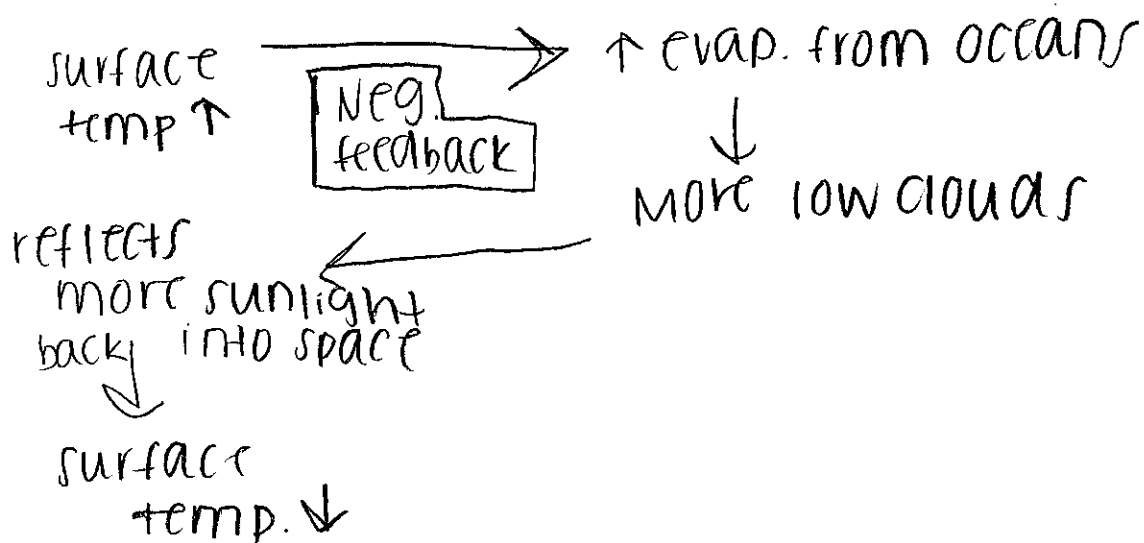
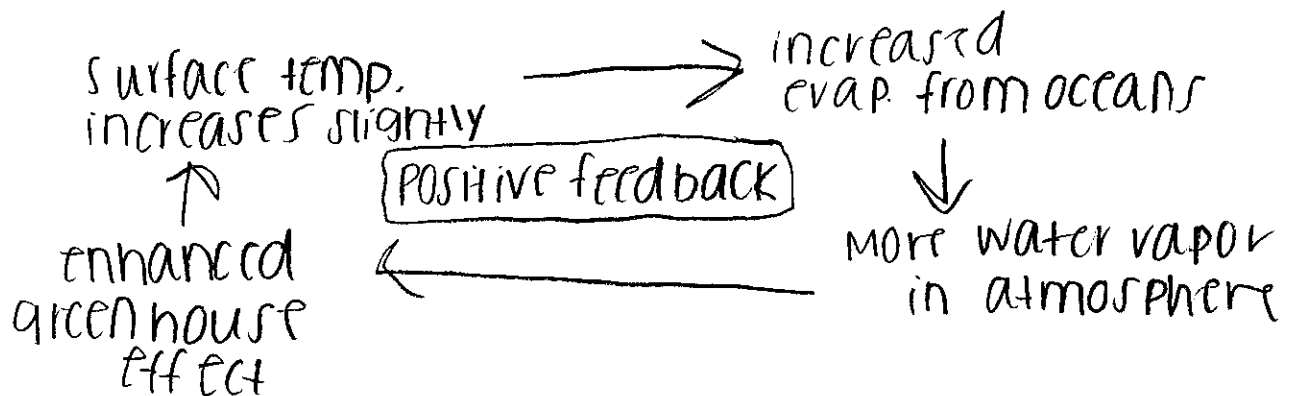
Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes



ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	+ carbon dioxide, methane released in atmosphere
Other babies wake up	+ temperature
Other babies start crying	+ permafrost thaw

greenhouse gas increase temp.
↓
melts permafrost
↓
causes more warming

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas cause ↑ temp.
Nurse feeds hungry baby	warming causes evap. & ↑ cloud cover
Hungry baby stops crying	
Other babies stop crying	

increasing CO₂

↓ weak warming

↓
↑ clouds let
↓ sunlight in

2

↓ even weaker warming

opposite / less of same

GROUP #: 2
Student IDs of Members Present:
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: change causes further change in system - increases overall change.
2. Negative feedback: change causes opposite reaction closer to equilibrium. decreases size of changes in system.

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

cloud cover keeps rise in temperature slowed, so there is less change or warming

- B. Which specific step makes this a negative feedback loop?

cloud covering sun's rays

- C. How might cloud cover produce a positive feedback?

There is more of the decrease in temperature.

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

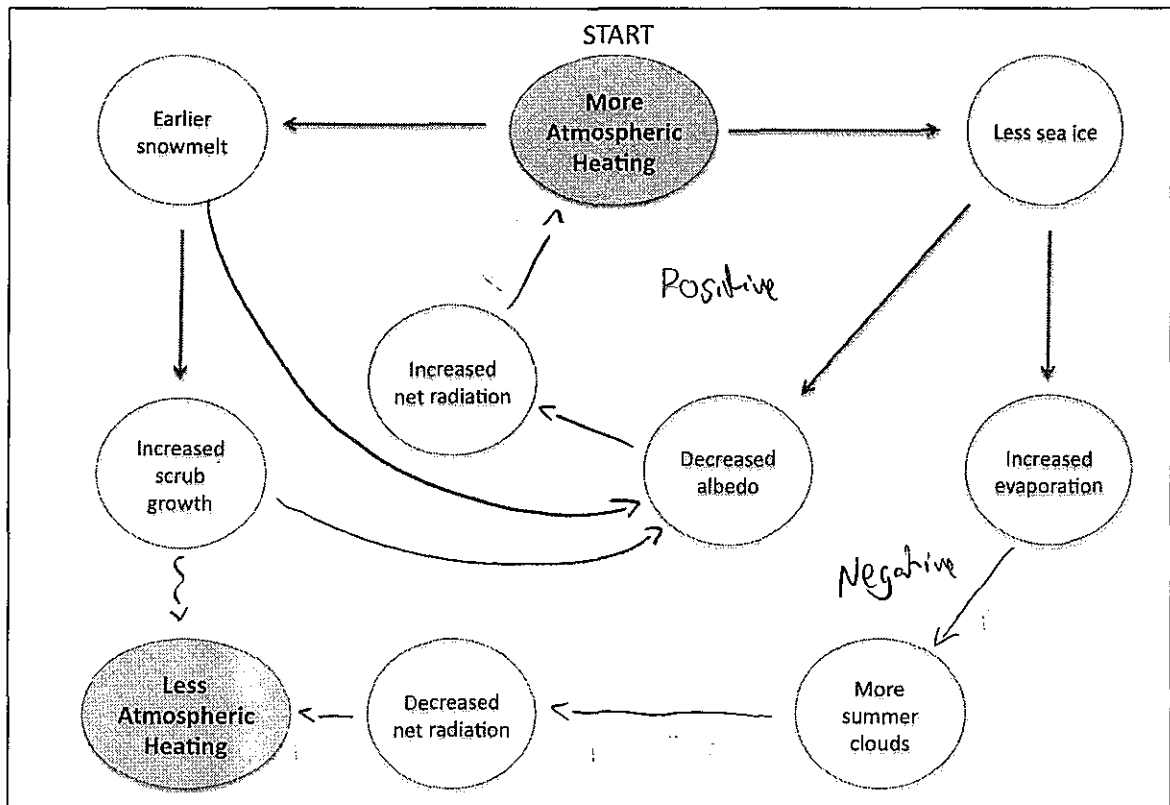
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive. As glaciers, ice sheets, etc melt due to increased temperature, less sunlight would be reflected and more would be absorbed and converted to heat, causing more warming.

ISP203A – Global Change
Feedback Loops

2

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More heat causes less sea ice which means increased evaporation which leads to more clouds which decrease net radiation making it cooler.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More heating causes less sea ice which decreases albedo causing increased net radiation meaning even more heating.

ISP203A – Global Change
Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change
Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
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PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

3

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Carbon dioxide and methane released into the atmosphere. Greenhouse gas causes increased warming.
Other babies wake up	Increases temperature. Warming melts permafrost and releases methane.
Other babies start crying	Increases the thawing of permafrost. This causes the greenhouse gases to increase warming even more.

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	Increased CO ₂ or other warming influence. Greenhouse gas cause increased warming.
Nurse feeds hungry baby	Weak warming. Warming causes evaporation and increased cloud cover.
Hungry baby stops crying	Increasing clouds lets in less sunlight. Cloud cover blocks sunlight, causing less warming.
Other babies stop crying	Even weaker warming. Cloud cover blocks sunlight, causing less warming.

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *a change in the system causes further changes in the system such that some component in the system increases overall.* ^{that} ^{as} ^{that} ^{on}
2. Negative feedback: *a change in a system causes an opposite response in the system such that the system is closer to equilibrium. It will decrease the size of the changes going on in the system.*

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?
Cloud cover is considered a negative feedback loop in a warming climate because greenhouse gases increase warming. Warming causes more evaporation which leads to an increase in condensation as well as an increase in cloud cover. This cloud cover will block sunlight, causing less warming.
- B. Which specific step makes this a negative feedback loop?
The specific step that makes this a feedback loop is the step in which cloud cover blocks sunlight which causes less warming. The fact that there's less warming due to an increase in cloud cover blocking sunlight shows that the system is having an opposite response, putting the system closer to equilibrium.
- C. How might cloud cover produce a positive feedback?
Cloud cover might produce a positive feedback if the cloud cover did not block so much sunlight. If there was cloud cover as well as sunlight, this could continue to happen with a help of them. It decreases in cloud cover. This does not mean that there would be no cloud cover, just smaller amounts of it.

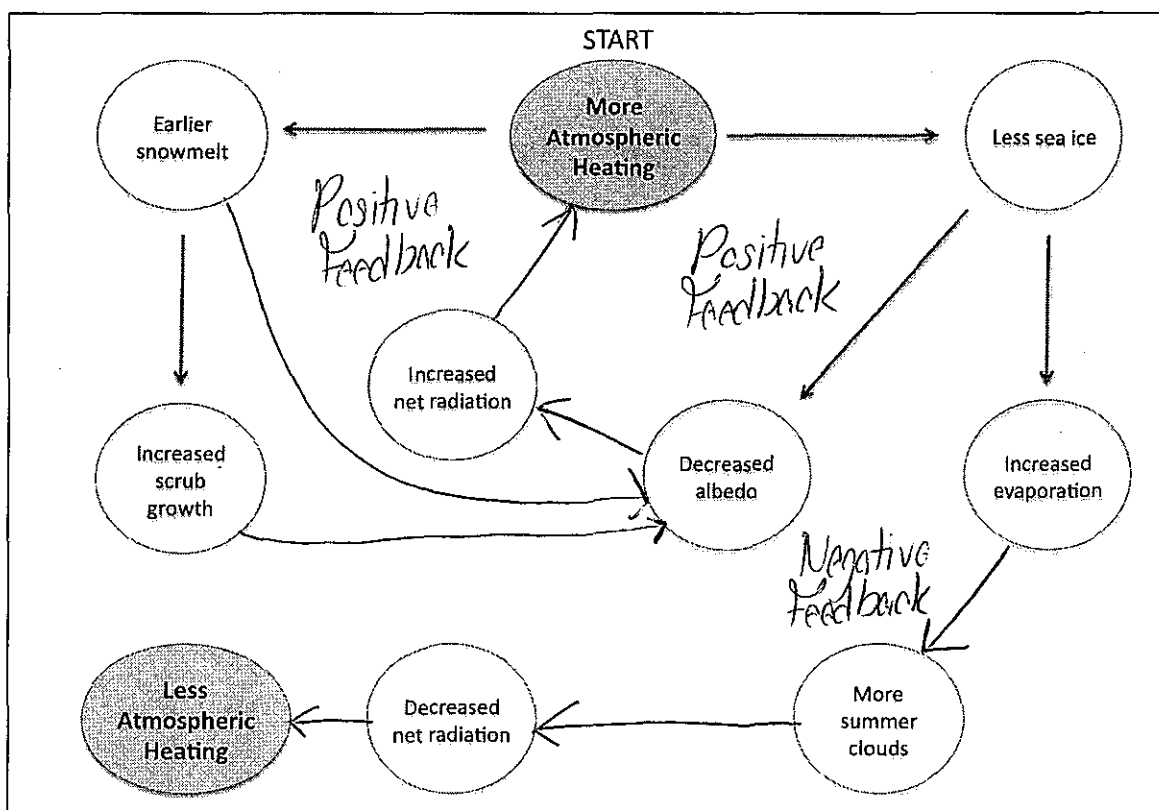
Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.
If global warming caused the loss of glaciers and ice sheets, this would result in a positive feedback loop. More global warming leads to less glaciers and ice sheets. This would result in more radiation being absorbed by the Earth's surface which is converted to thermal energy. Greenhouse gases will increase and continue to absorb the thermal energy, which will continue in more loss of glaciers and ice sheets.

3

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

~~Reduced forest area~~ Cloud cover is an example of a negative feedback loop. Refer to page 2.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

~~Permafrost is an example of a positive feedback loop~~ Permafrost in the Arctic is an example of a positive feedback loop. Refer to page 2.

ISP203A – Global Change
Feedback Loops

Part 3: Homework

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- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change Feedback Loops



Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
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8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

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Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Greenhouse gas cause increased warming
Other babies wake up	melts permafrost
Other babies start crying	CO ₂ & methane gets released

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas cause increased warming
Nurse feeds hungry baby	warming causes evaporation + more cloud cover
Hungry baby stops crying	cloud cover blocks sunlight causing less warming
Other babies stop crying	

GROUP #: 4
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: causes a continuous change
a
2. Negative feedback: causes an opposite change

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

When there is an increase in temperature which increase in evaporation + cloud formation which causes decrease in earth's temperature because of the blocking of the sun.

B. Which specific step makes this a negative feedback loop?

The increase in temperature leads to a decrease in temperature because of the cloud cover.

C. How might cloud cover produce a positive feedback?

After cloud cover, the earth's temperature decreases thus decreasing evaporation which produces less clouds. Less clouds increases earth's temperature which increases evaporation creating more clouds + cloud cover + ~~staying around~~ + it begins again.

Albedo:

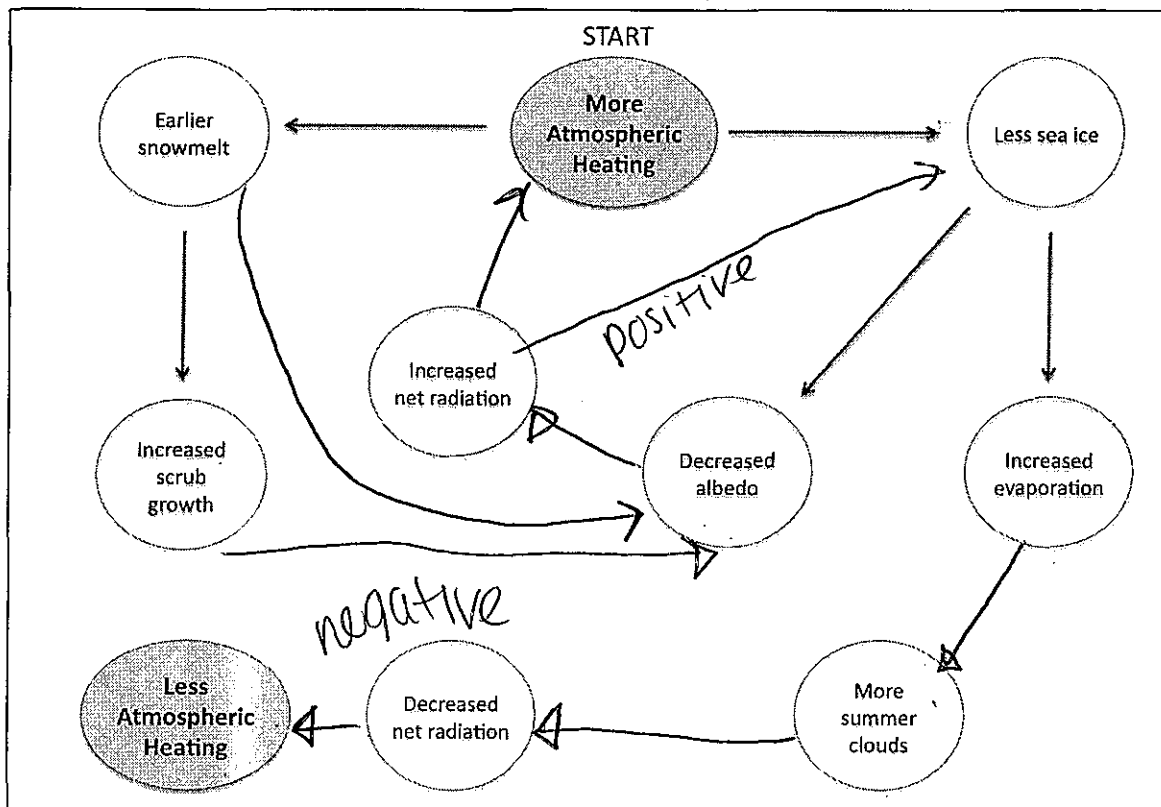
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This would be a positive feedback loop. The glaciers reflect the sun's radiation which leads to cooler temperatures but if we lose part of the glaciers due to global warming then the sun's radiation will be absorbed by the earth causing continuous change which would be a positive feedback loop.

4

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More atmospheric heating leads to less sea ice eventually leading to less atmospheric heating. the two balance more heating to less heating equalizes the system and goes to the atmosphere.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

As the atmosphere heats the ice will melt. this leads to less albedo (which reflects sunlight away from earth) which leads to less radiation increasing the temp. of atmosphere. & everytime it goes through a loop it makes atmosphere warmer + further from equilibrium

ISP203A – Global Change
Feedback Loops

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Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

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ISP203A – Global Change Feedback Loops

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PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.



Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	A Process releases carbon dioxide into the atmosphere, which causes warming ↑ methane
Other babies wake up	warming melts Permafrost releasing methane
Other babies start crying	This keeps going and going!

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	Greenhouse gas causes increased warming.
Nurse feeds hungry baby	warming causes evaporation and more cloud cover.
Hungry baby stops crying	Cloud cover causes less warming.
Other babies stop crying	

GROUP #: 5
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change in a system that causes further changes in the system such that the system increases overall.
2. Negative feedback: A change in a system that causes an opposite response in the system that the system is closer to equilibrium.

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

This is considered a negative feedback loop because the Sun's light/energy is reflected back into space, causing some cooling.

B. Which specific step makes this a negative feedback loop?

What makes this a negative feedback loop is that the warming causes more cloud cover through evaporation.

C. How might cloud cover produce a positive feedback?

Cloud cover blocks sunlight, causing less warming.

Albedo:

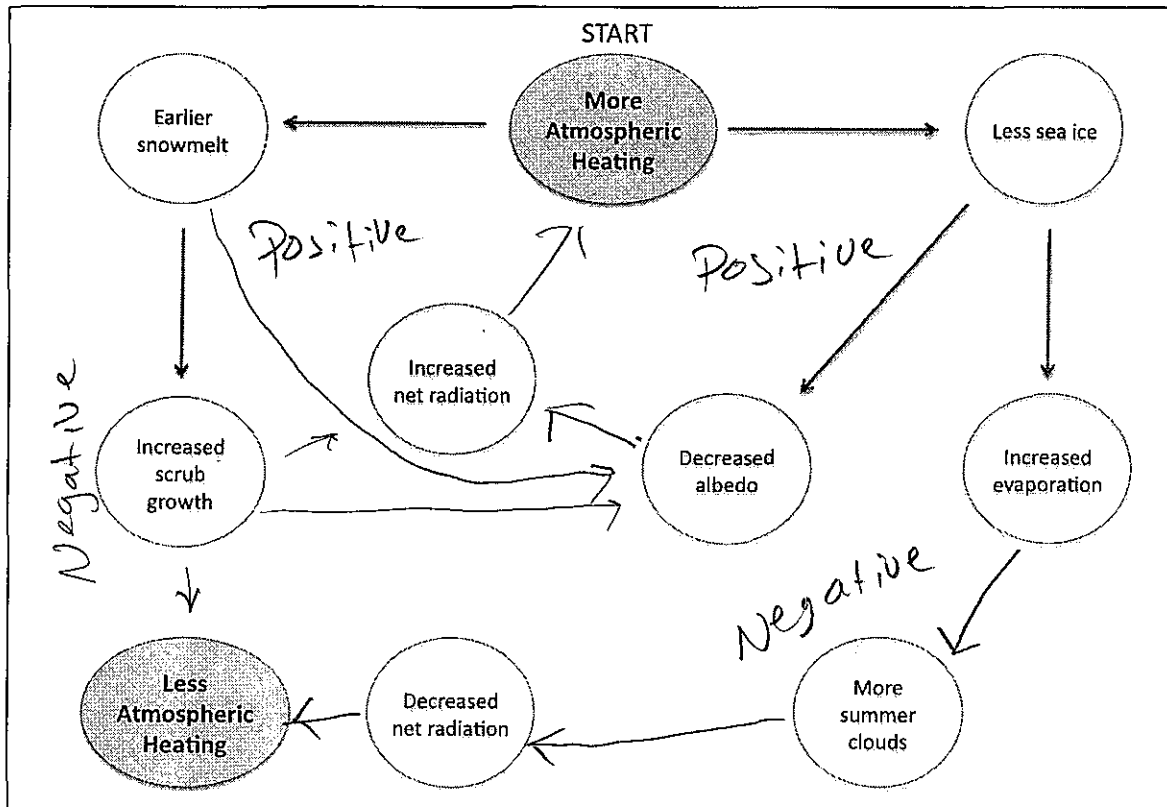
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This is a positive feedback loop because the less ice there is in polar ice caps and in glaciers, the more the earth is going to warm, increasing overall change in the system.

5

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

If there's less sea ice, this causes more evaporation, which in turn causes there to be more cloud cover; then, because the clouds reflect the Sun's energy into space there will be less heating. This brings

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

With increased CO₂ emissions, there will be more greenhouse gases in the atmosphere. This causes the temperature to rise, which kicks off a litany of other things to happen. Further warming the Earth, this moves the system away from equilibrium by increasing the speed at which the Earth is warming.

The system closer to equilibrium by slowing the positive feedback loop of global warming.

ISP203A – Global Change Feedback Loops

Objectives

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Causal Principles

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PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

6

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Methane gets released increased temp
Other babies wake up	increased temp melts permafrost
Other babies start crying	melting permafrost releases methane

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	Increased warming by G.G.
Nurse feeds hungry baby	warming causes evaporation & cloud cover
Hungry baby stops crying	cloud cover blocks sun
Other babies stop crying	less sun = less warming

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: One change causes another change of the same kind.

2. Negative feedback: One change causes another change to slow, stop, or change in opposite direction

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

When temp increases water vapor condenses which causes more clouds, those clouds block sun which causes the temp to lower.

B. Which specific step makes this a negative feedback loop?

The clouds blocking sunlight

C. How might cloud cover produce a positive feedback?

more clouds = less water vapor ^{in atmosphere} = less of greenhouse gases in atmosphere = less g.h. gases to trap heat & warm earth.

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

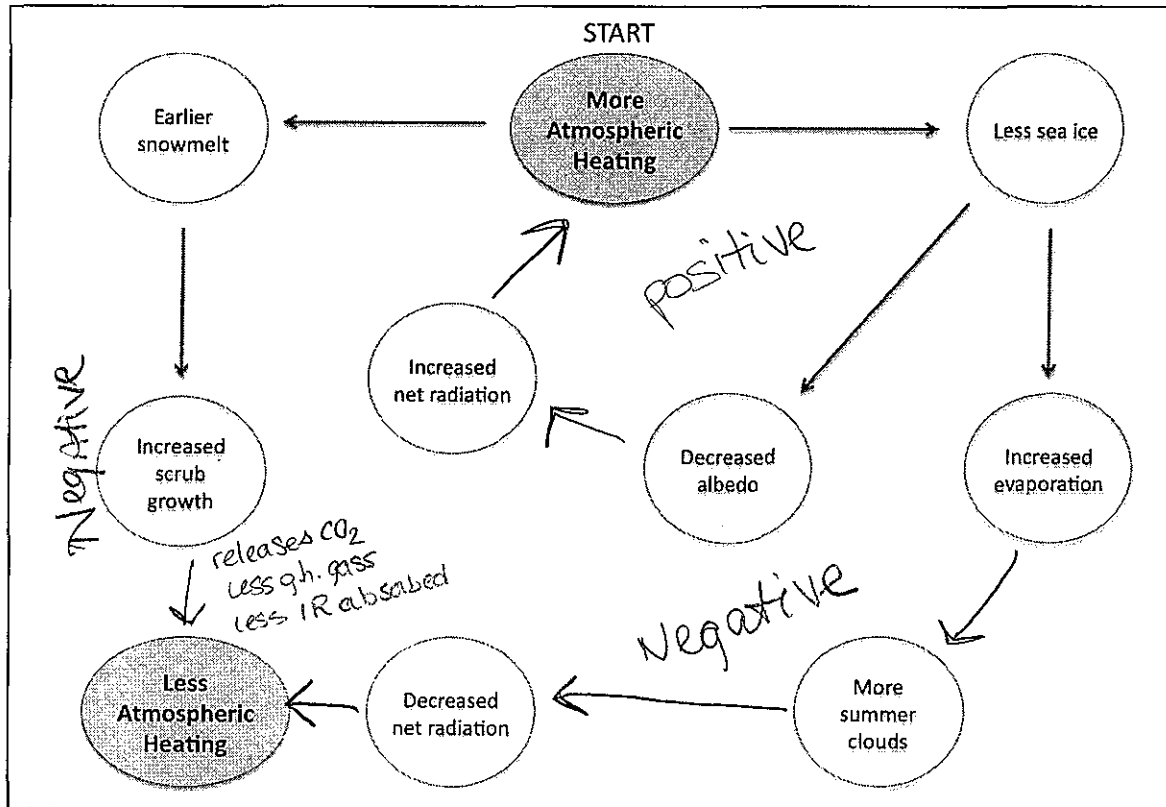
Positive feedback.

Global warming melts glaciers allowing more sunrays & heat to be trapped in earth's atmosphere which would heat the earth more.

ISP203A – Global Change
Feedback Loops

6

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

ISP203A – Global Change
Feedback Loops

Part 3: Homework

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The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
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Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change Feedback Loops

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PART 1: Background Notes

Positive feedback: a change in the system causes further changes in the system such that some component in a system increases overall

negative feedback: a change in a system causes an opposite response in the system such that the system is closer to equilibrium. In this case, the negative feedback component will decrease the size of changes going on in the system.

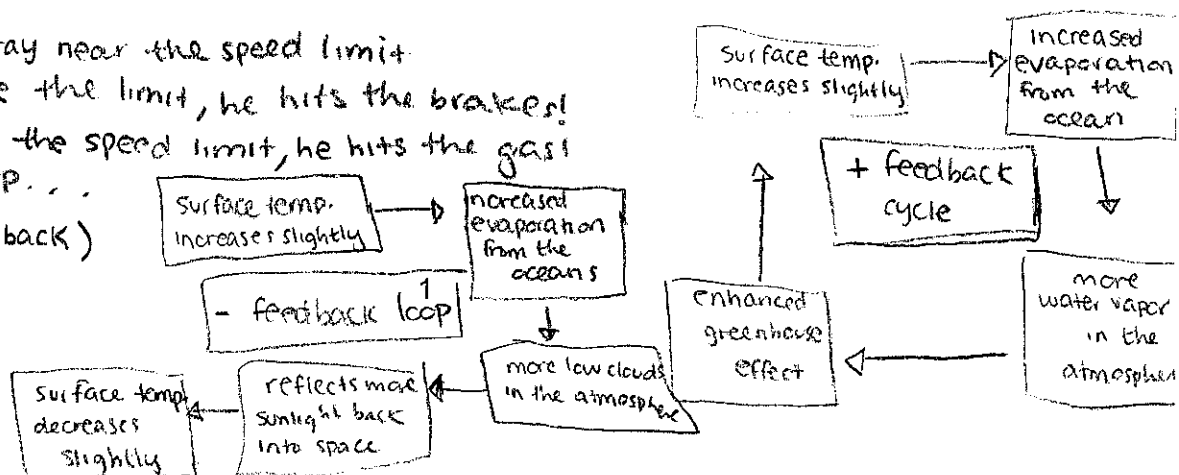
- not good or bad

ex: A daycare full of sleeping children. One wakes up and makes a little noise, which wakes up a couple others, who make noise... soon everyone is awake!
(positive feedback)

ex: driver trying to stay near the speed limit

- As he gets above the limit, he hits the brakes!
- As he gets below the speed limit, he hits the gas!
- IF he sees a cop...

(negative feedback)



ISP203A – Global Change
Feedback Loops

1

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	greenhouse gas cause increased warming
Other babies wake up	warming melts permafrost and releases methane
Other babies start crying	greenhouse gas causes more increased warming

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas cause increased warming
Nurse feeds hungry baby	warming causes evaporation and increased cloud cover
Hungry baby stops crying	cloud cover blocks sunlight causing less warming
Other babies stop crying	↓

GROUP #: 7
Student IDs of Members Present:
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: a change of the system that causes more of the same thing.
2. Negative feedback: a change of the system that causes less or the opposite of something.

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

It reflects the sunlight and causes less warming.

B. Which specific step makes this a negative feedback loop?

reflecting more sunlight back to space.

C. How might cloud cover produce a positive feedback?

if the cycle kept continuously created more of the same change it would be positive feedback.

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

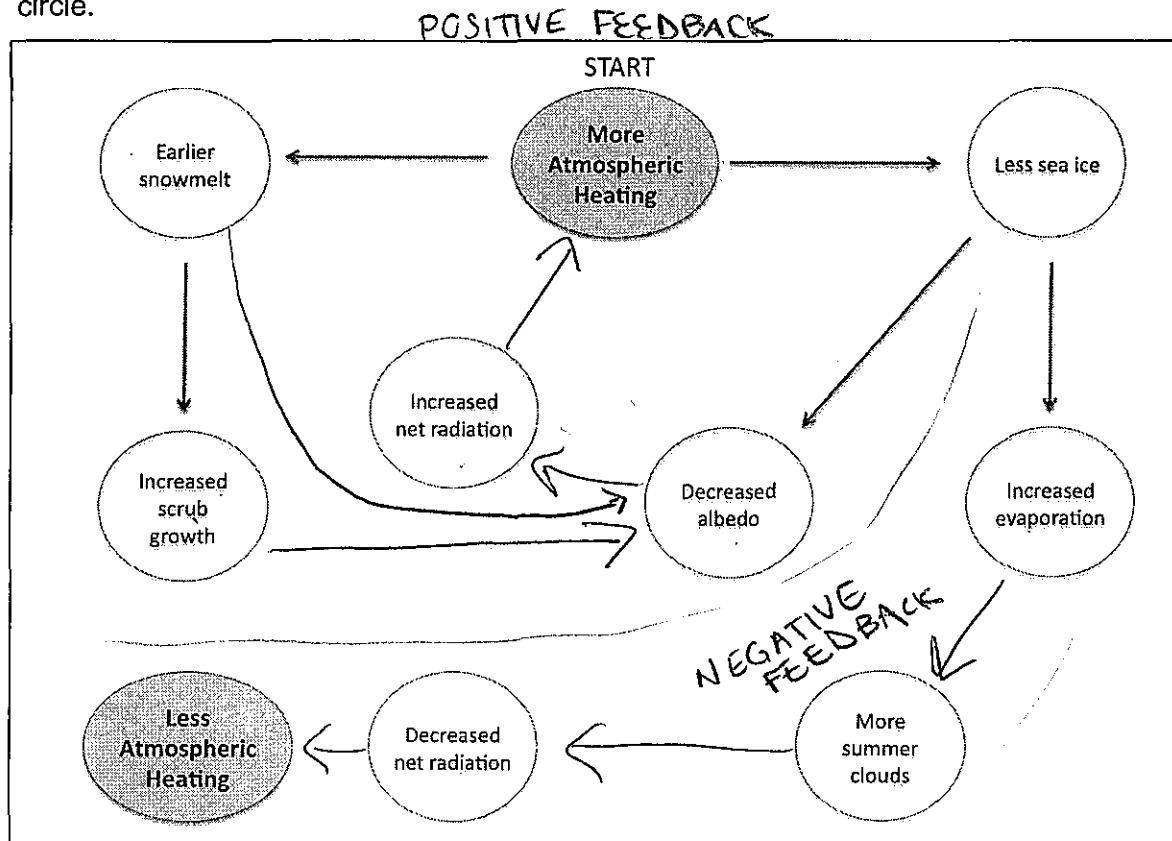
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This is positive feedback because as the glaciers and ice sheets melt, the earth absorbs more sun radiation therefore warming the earth. This cycle just keeps causing more of the same change, which is why its positive Feedback.

ISP203A – Global Change
Feedback Loops

7

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

the negative creates more water vapor which creates more clouds, blocking the sun from heating the atmosphere as much.

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

By increasing the amount of plants in the atmosphere, the amount of greenhouse gases will decrease which will make the temperature decrease.

ISP203A – Global Change
Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

8

GROUP #: 8
Student IDs of Members Present:
A42311768
A43866027

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Something causes more of the same thing to happen
2. Negative feedback: Something causes an event that causes less of the same or exact opposite

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because with increased cloud cover results in weaker warming.

- B. Which specific step makes this a negative feedback loop?

Where sunlight is reflected back into space

- C. How might cloud cover produce a positive feedback?

If there was less cloud cover so that not as much light was reflected back.

Albedo:

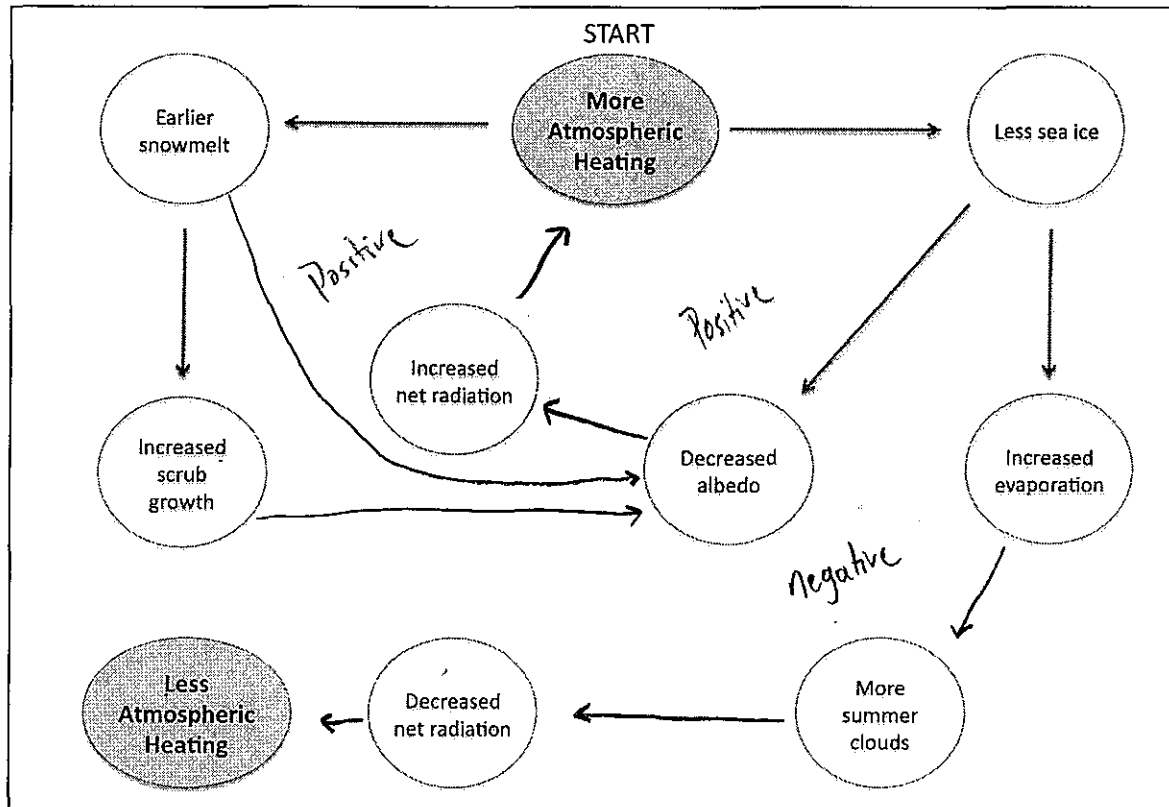
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Negative feedback because with absorbing and reflecting, with one missing it would not be at equilibrium and over time the ice would all be gone.

ISP203A – Global Change Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The atmospheric heating causes less sea ice and continues to melt causing evaporation into clouds cause more cloud cover and less atmospheric heating.

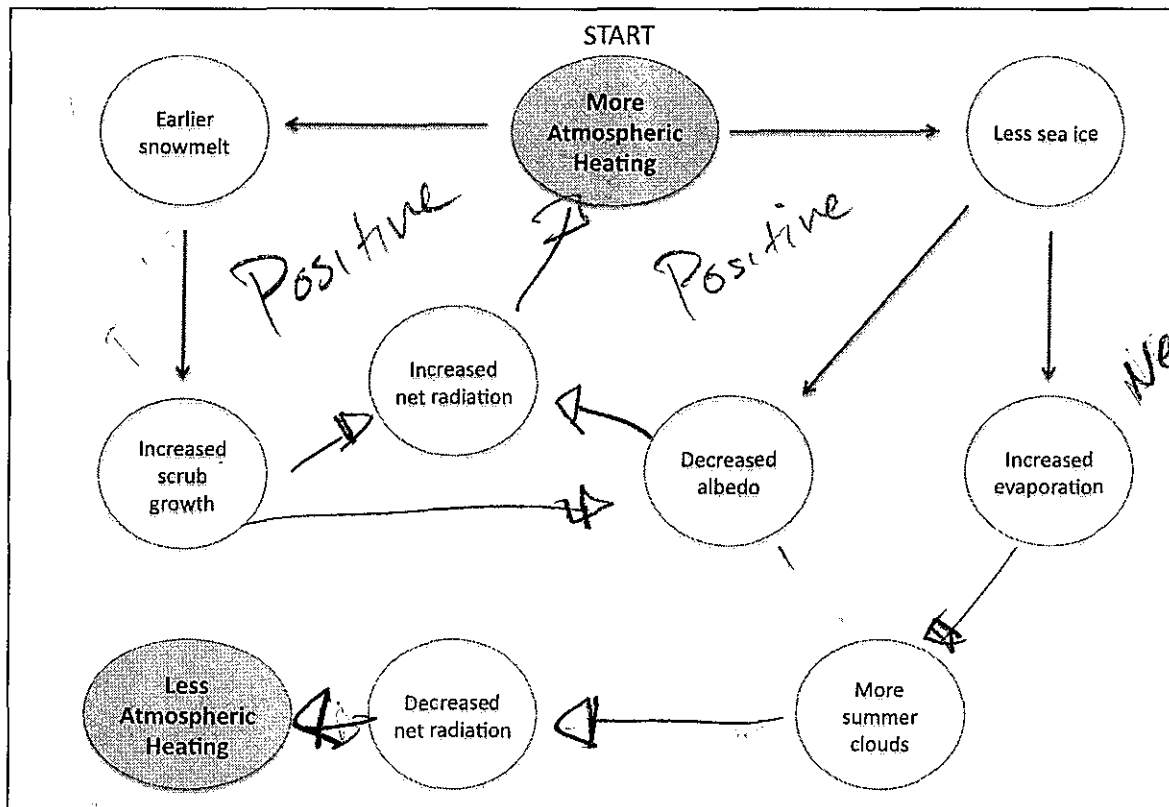
F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

There is a constant heating increases temperatures and there will be no equilibrium because nothing will be reflected and it will continue to get warmer.

ISP203A – Global Change
Feedback Loops

9

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

less sea ice leads to increased evaporation which leads to more clouds so the clouds cool the atmosphere which brings temps back to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Positive loop would be more atmospheric heating leading to earlier snowmelt leading to increased scrub growth, leading to increased net radiation leading to more heating so this is a positive feedback because things keep getting warmer moving further from equilibrium.

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: In the same way
2. Negative feedback: In the opposite way

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because it makes the climate cooler.

B. Which specific step makes this a negative feedback loop?

The clouds reflecting heat.

C. How might cloud cover produce a positive feedback?

If it was always cloudy it could make things always be cooler which could spur more cooler temperatures.

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback because less radiation would be reflected & would eventually make things continue to go warmer.

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	CO₂ + methane released into greenhouse gas caused increased warming
Other babies wake up	warming melts permafrost & release methane
Other babies start crying	greenhouse gas cause permafrost to melt

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas causes increased warming
Nurse feeds hungry baby	warming causes evaporation & increased cloud cover
Hungry baby stops crying	cloud cover blocks sunlight
Other babies stop crying	less of same

GROUP #: 11
Student IDs of Members Present:
A43835916
A43773910

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *when changes cause more of same change*
2. Negative feedback: *when changes cause an opposite response of change*

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

the cloud cover ~~makes~~ reduces the amount of sunlight that reaches the earth

- B. Which specific step makes this a negative feedback loop?

Cloud cover blocks sunlight, causing less warming

- C. How might cloud cover produce a positive feedback?

if we start the cycle in a different place such as when cloud cover lets in less sunlight, so it continues to let in less sunlight making it more of the same effect.

Albedo:

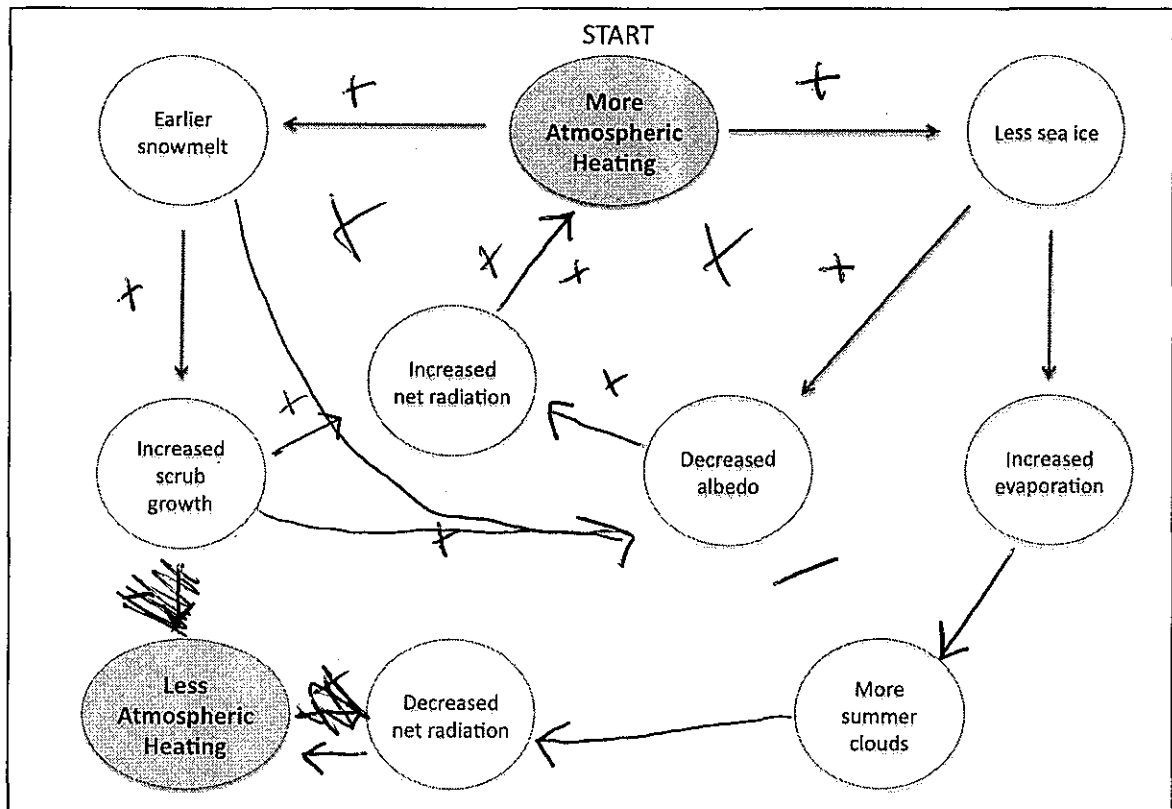
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive, more radiation would be absorbed by earth's surface

ISP203A – Global Change
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



- E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The cloud covering lets less sunlight in causing a decrease in warming, bringing the earth's temperature back to equilibrium.

- F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Permafrost increases greenhouse gases which causes increased warming of the earth, then warms & melts the permafrost releasing methane, which in turn adds to the greenhouse gases.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

12

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Carbon dioxide and methane released into atmosphere
Other babies wake up	Temperature increase
Other babies start crying	Permafrost thaws / temp increased

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas increases warming
Nurse feeds hungry baby	more evaporation & decreased warming
Hungry baby stops crying	more cloud cover
Other babies stop crying	decreased warming

ISP203A – Global Change
Feedback Loops

Two guys joined
from group #17
A42503261
A41727610

GROUP #: 12
Student IDs of Members Present:
A43365634 A43272425
A40920866 A43506836

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: a change in the system causes further changes such that some component increases overall
2. Negative feedback: a change in the system causes a decrease in the size of changes such that some components decrease overall

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because it starts out increasing warming which increases cloud cover (evaporation) and overall warming decreases

B. Which specific step makes this a negative feedback loop?

The increase in cloud cover which decreases warming

C. How might cloud cover produce a positive feedback?

Because by itself it is a positive feedback because it decreases warming, because you release precipitation and release heat into the atmosphere

Albedo:

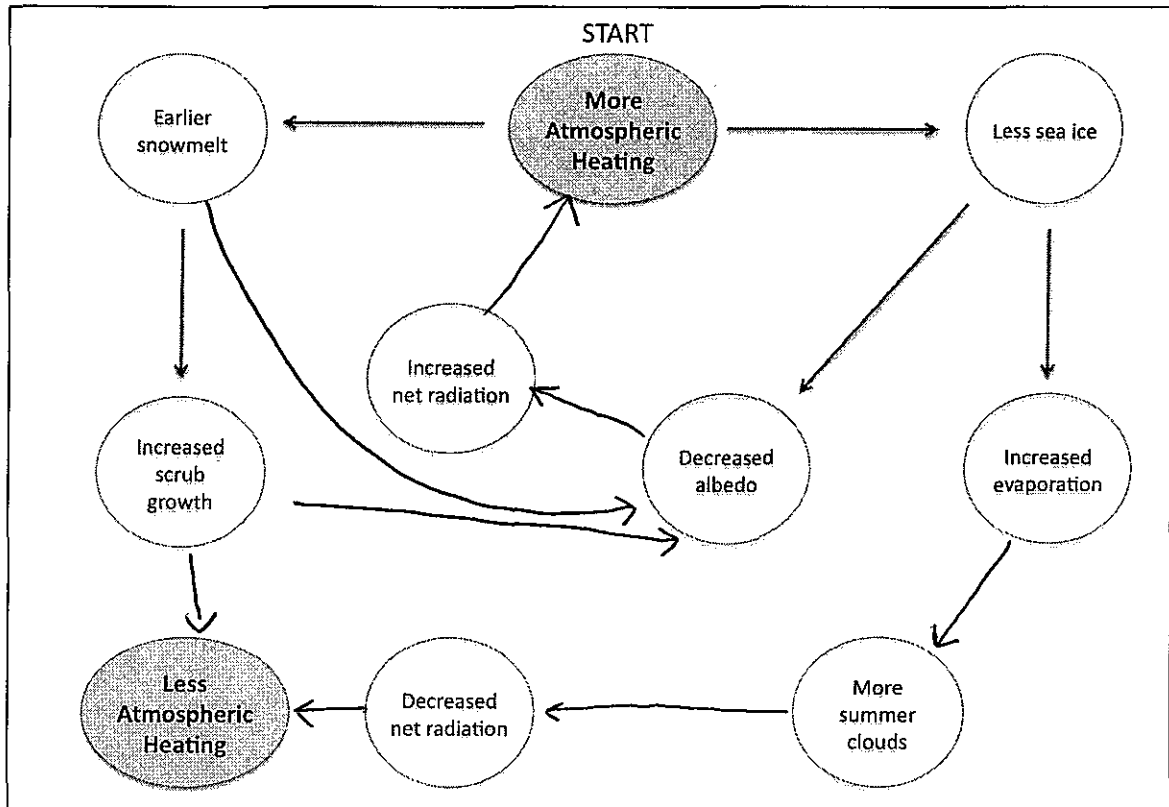
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback loop because an increase in warming would melt glaciers & ice sheets would cause the earth surface to absorb more heat and increase warming

ISP203A – Global Change
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

If you increase the atmospheric heating there will be less ice which would increase evaporation and therefore more cloud cover and atmospheric cooling

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Because if there is more atmospheric heating it would decrease albedo which would increase the overall temperature because the ground would absorb more thermal energy

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change Feedback Loops

13

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

13

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	CO ₂ & Methan released
Other babies wake up	temperature goes up melts permafrost
Other babies start crying	GH gases cause increase in temp permafrost melts

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	GH gas causes increased warming
Nurse feeds hungry baby	warming causes evaporation
Hungry baby stops crying	cloud cover blocks sunlight, causing less warming.
Other babies stop crying	

GROUP #: 413

Student IDs of Members Present:

~~XXXXXXXXXX~~ A42957208

~~XXXXXXXXXX~~ A42096024

~~XXXXXXXXXX~~ A43819247

~~XXXXXXXXXX~~ A42097647

~~XXXXXXXXXX~~ A421232

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

2. Negative feedback:

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because warmer temps = more evaporation which leads to more cloud cover and cooler temps

B. Which specific step makes this a negative feedback loop?

more cloud cover which decreases temps

C. How might cloud cover produce a positive feedback?

Cloud cover can trap in GH gases and increase temperatures.

Albedo:

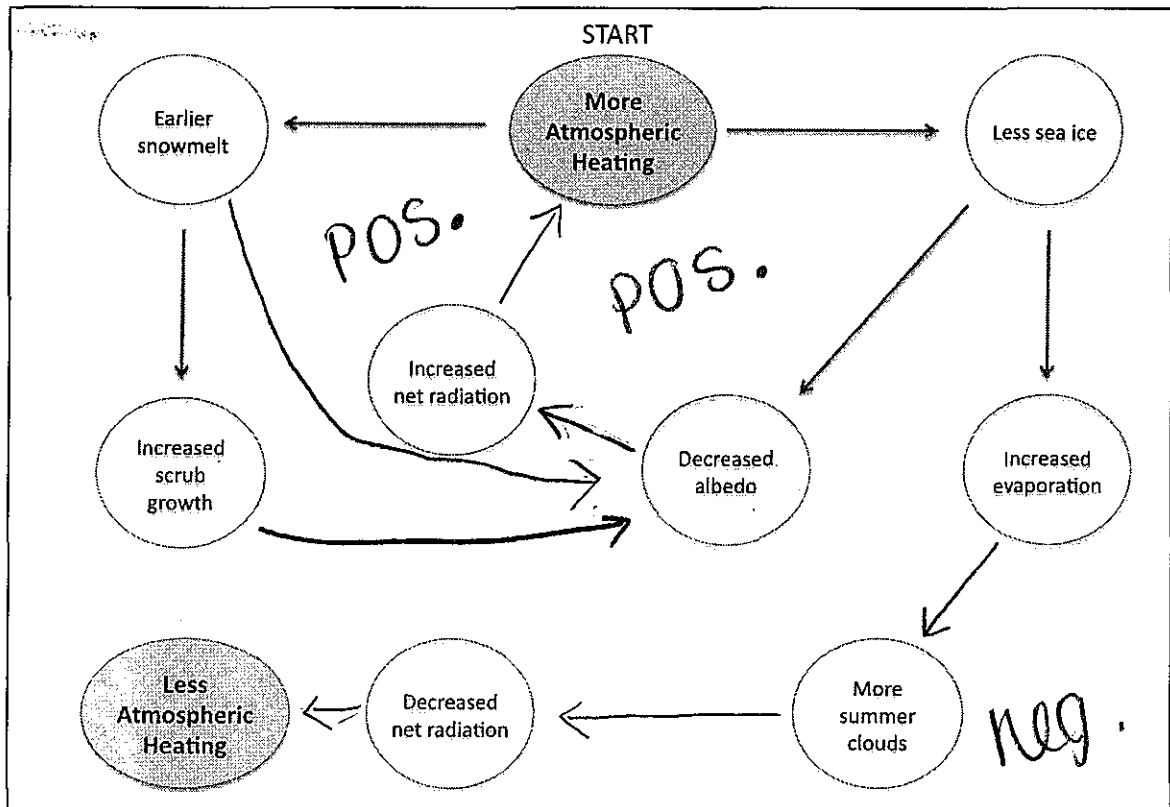
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

positive feedback loop. Less Glacier coverage creates more heat being absorbed by the land & melts the glacier coverage which means more Earth will be exposed & more heat will be absorbed.

13

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more heating to cause less heating.
it brings close to equilibrium
by equaling hot & cold

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More atmospheric heating to more atmospheric heating. It moves it away from equilibrium by causing more heating.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	
Other babies wake up	
Other babies start crying	

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	
Nurse feeds hungry baby	
Hungry baby stops crying	
Other babies stop crying	

GROUP #: 14
Student IDs of Members Present:
A43376720
A43219269
A39222014

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

what is happening reinforces behavior
to continue or increase

2. Negative feedback:

behavior changes or reverses

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

cloud cover cools down the environment

B. Which specific step makes this a negative feedback loop?

cloud cover blocks sunlight
causing less warming

C. How might cloud cover produce a positive feedback?

if temp is already dropping
cloud cover causes it to drop more.
also if it reflects UV.

Albedo:

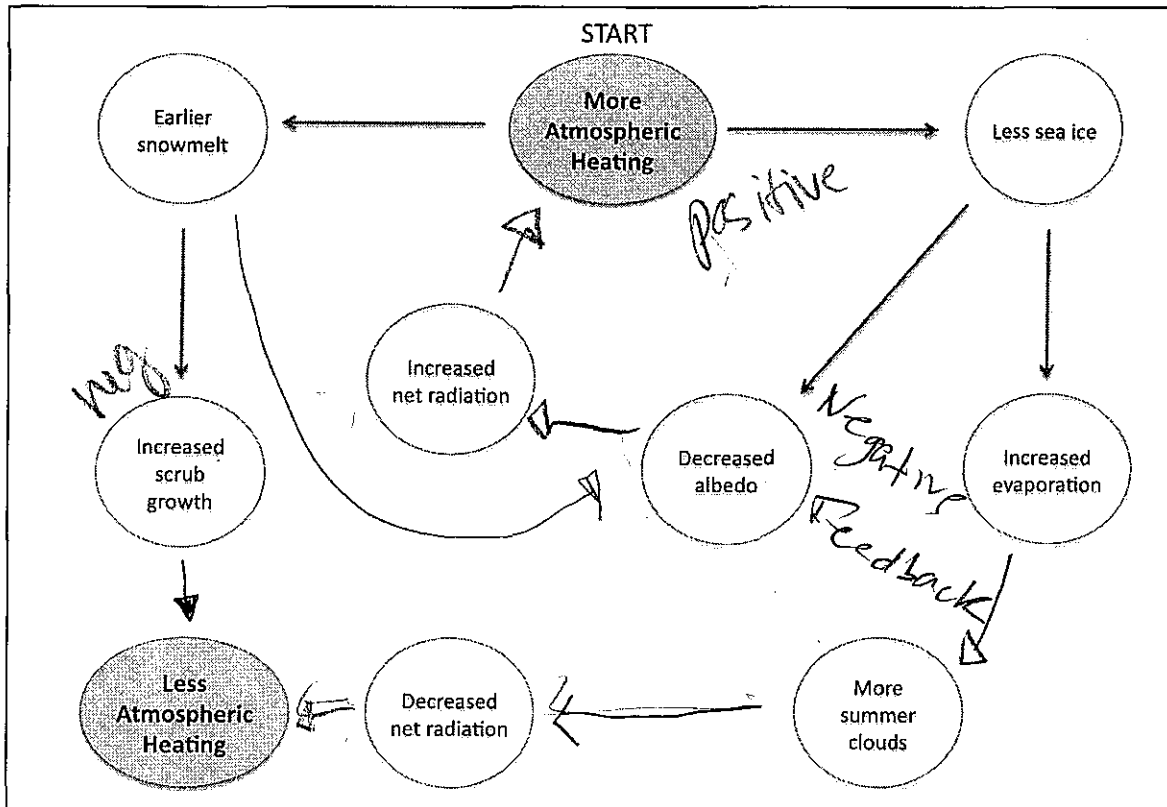
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would be positive because as the ice melts
because of warmer temp, it would cause the
earth to get warmer still because with
less ice more of the sun's radiation is
absorbed.

14

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More heating leads to less sea ice which leads to inc. evaporation which eventually leads to less heating.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More heating leads to less sea ice which can lead to dec. albedo which inc. net radiation which goes back to causing more heating.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

15

GROUP #: 15
Student IDs of Members Present:
D. [redacted] - A41021960
E. [redacted] - A42669701
S. [redacted] - A40641748

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Change in the system causes further changes in the system such that some component in the system increases overall.

2. Negative feedback: A change in a system causes an opposite response in the system such that the system is closer to equilibrium.

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Greenhouse gases causes increased warming. Warming causes evaporation and increases cloud cover. Cloud cover blocks sunlight, causes less warming.

B. Which specific step makes this a negative feedback loop?

Cloud cover blocks sunlight, causes less warming. Greenhouse gas is causing increased warming which causes evaporation which results in less warm water.

C. How might cloud cover produce a positive feedback?

Lower temp.'s cause condensation, hence cloud cover. This would increase cloud cover, increase Earth's reflected radiation further cooling the climate.

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

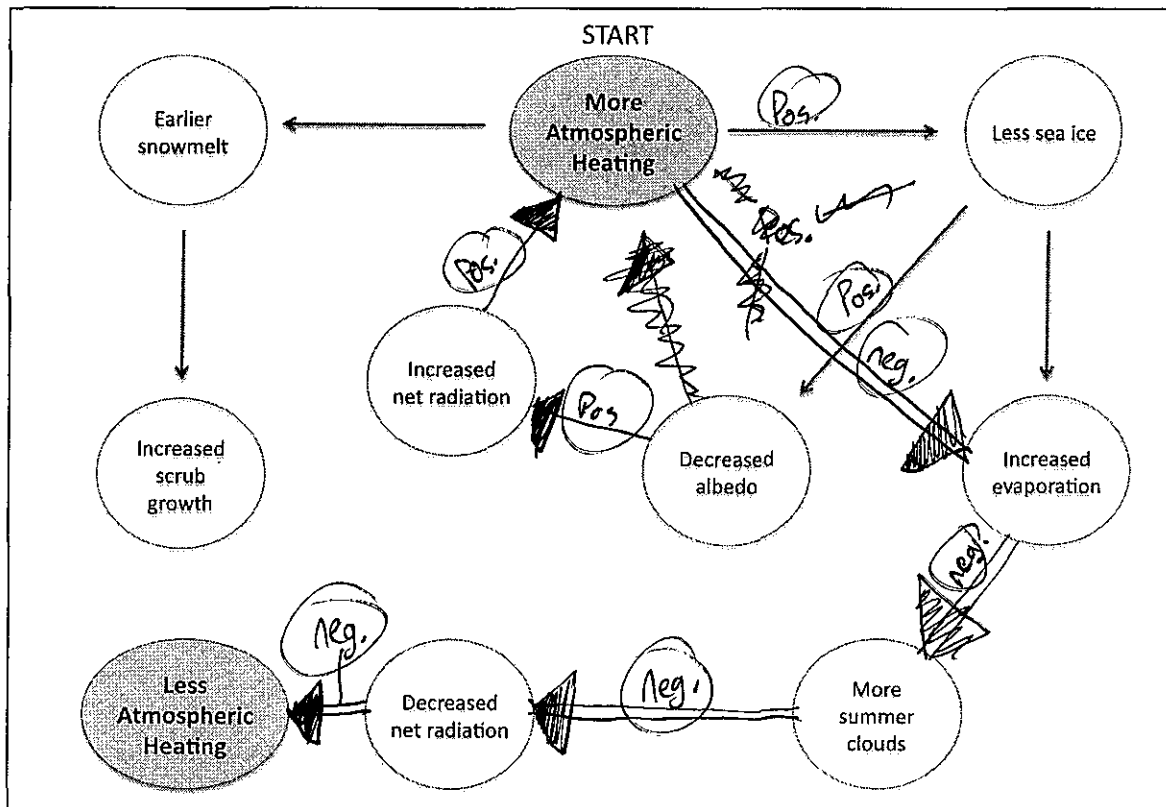
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback loop - Increased global warming would cause the loss of glaciers and ice sheets, which would decrease the amount of solar radiation being reflected into space. This would increase Earth's absorption of radiation, speeding global warming.

ISP203A – Global Change
Feedback Loops

15

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More atmospheric heating → increased evap. → more summer clouds →
→ decreased net radiation → less atmos. heating

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmosphere heating → less sea ice → decreased albedo →
→ increased net radiation → more atmospheric heating

GROUP #: **16**
Student IDs of Members Present:
A40974799 [REDACTED]
A37497963- [REDACTED]
43145662 [REDACTED]

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: a relationship between 2 factors in which a change in one leads to a corresponding change in another (ie both increase or decrease)
2. Negative feedback: a relationship in which a change in one component leads to an opposite reaction in the other (ie one increasing causes the other to decrease)

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because sunlight comes in and bounces off it, decreases surface temperature
ie: increased cloud cover → decreased temperature

B. Which specific step makes this a negative feedback loop?

Decreased temperature

C. How might cloud cover produce a positive feedback?

In a cold climate increased cloud cover would lead to "increased" cooling

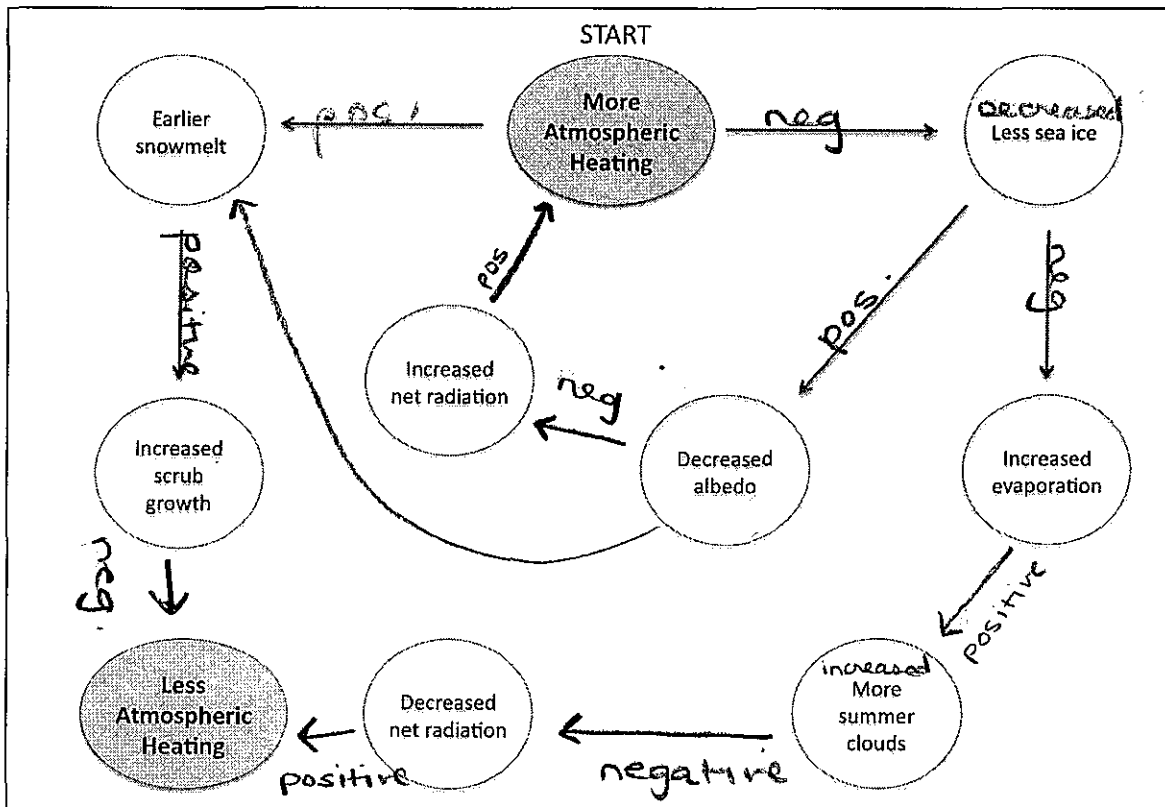
Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Less ice leads to decreased albedo which leads to increase in energy radiated toward atmosphere = Negative feedback loop; decreased albedo leads to increased reflected radiation

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



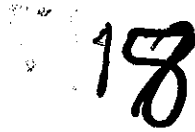
E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

increased shrub grow decreases greenhouse gases in the atmosphere, decreasing atmospheric heating. keeps equilibrium by balancing CO₂ outputs

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

less sea ice → decreased albedo = less radiation reflected back. moves away from equilibrium by allowing too much radiation beginning neg. feed back of increasing temp.

ISP203A – Global Change
Feedback Loops



Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Green house gases increase Global warming
Other babies wake up	warming then melts Permafrost Releases methane
Other babies start crying	The cycle keeps occurring.

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	Green house cause Increase warming
Nurse feeds hungry baby	warming raises evaporation and increases cloud cover
Hungry baby stops crying	
Other babies stop crying	

Cloud cover causes Blocks sunlight
causes less warming

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: when one action ~~causes~~ or event causes the same thing to keep occurring
2. Negative feedback: when one action or event causes the opposite thing to occur. (less of the same or opposite)

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

Cloud cover would be considered a negative feedback because greenhouse effect causes ~~global warming~~ greenhouse effect, which warms and causes more evaporation, which creates increase cloud cover and less warming.

- B. Which specific step makes this a negative feedback loop?

The fact that cloud cover makes the atmosphere less warm means less evaporation, which would mean a decrease in cloud coverage and more warming again.

- C. How might cloud cover produce a positive feedback?

Because if clouds are around for long enough then the atmosphere may continue to just get ~~warm~~ colder and colder.

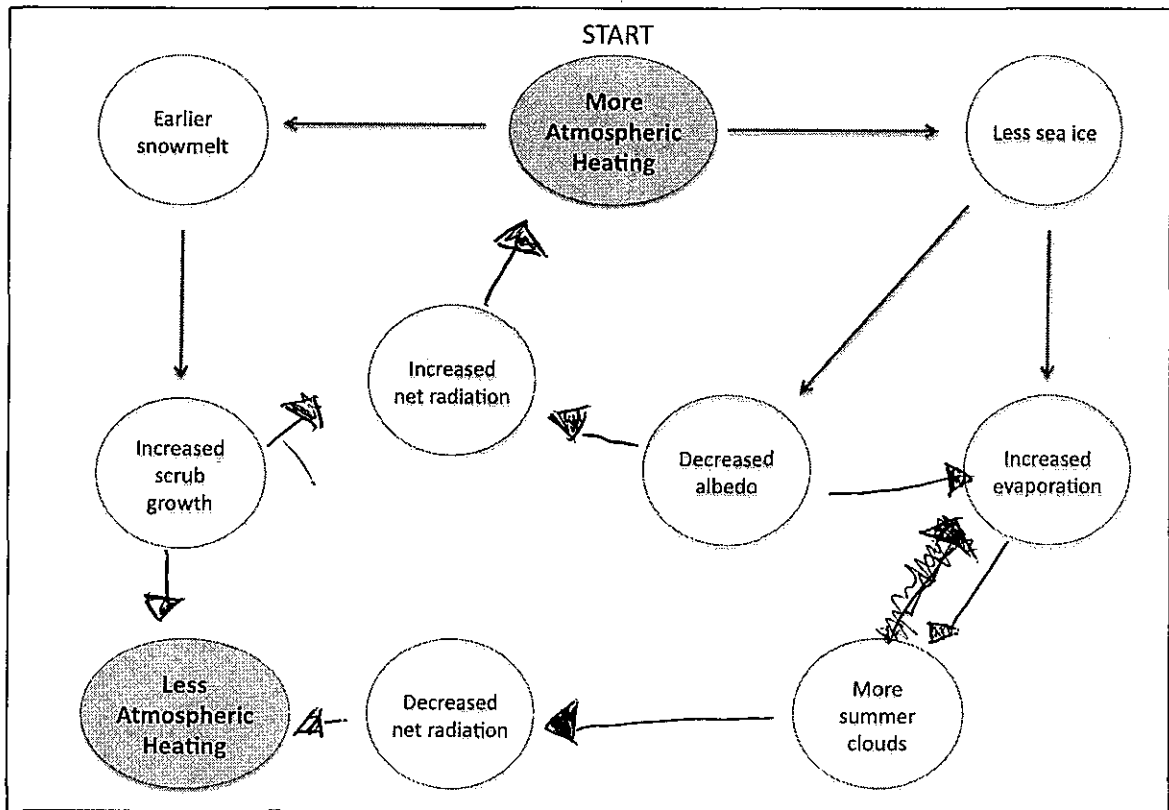
Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Global warming causes a loss of glaciers and ice sheets which would be a positive feedback. This is because with less glaciers and ice more thermal energy would be absorbed by greenhouse gases ~~instead~~ instead of the radiation just being reflected right back out of the atmosphere. Less ice = more thermal energy and more warming.

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

less sea ice means increase evaporation which means more summer clouds which means less radiation and less heating. by the heat being less it makes less more clouds and turns less sunlight to the surface

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More atmospheric heating causes an earlier snowmelt which would mean increased plant growth. More plants means more increased net radiation and keeps the atmosphere hot because the effect keeps being positive with nothing to slow it down.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

ISP203A – Global Change
Feedback Loops



Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

Positive - same way
Negative - opposite direction

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Greenhouse gas cause increased warming
Other babies wake up	warming melts permafrost and releases methane
Other babies start crying	

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	Greenhouse gas cause increased warming
Nurse feeds hungry baby	Warming causes evaporation and increase cloud cover
Hungry baby stops crying	Cloud cover blocks sunlight causing increase in warming
Other babies stop crying	↓

GROUP #: 19
Student IDs of Members Present:
A46212900 ~~XXXXXXXXXX~~
A40749278
A42257459

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *same way change continues in ↑*
2. Negative feedback: *opposite way / continues in opposite way*

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

stops energy from sun from hitting like it would normally if there was positive feedback.

- B. Which specific step makes this a negative feedback loop?

Normally when the sun hits the earth it warms the climate but because the infrared heat hits the cloud the earth is not warmed up ^{as much} causing neg. feedback

- C. How might cloud cover produce a positive feedback?

If it's always cloudy and no space with no cloud

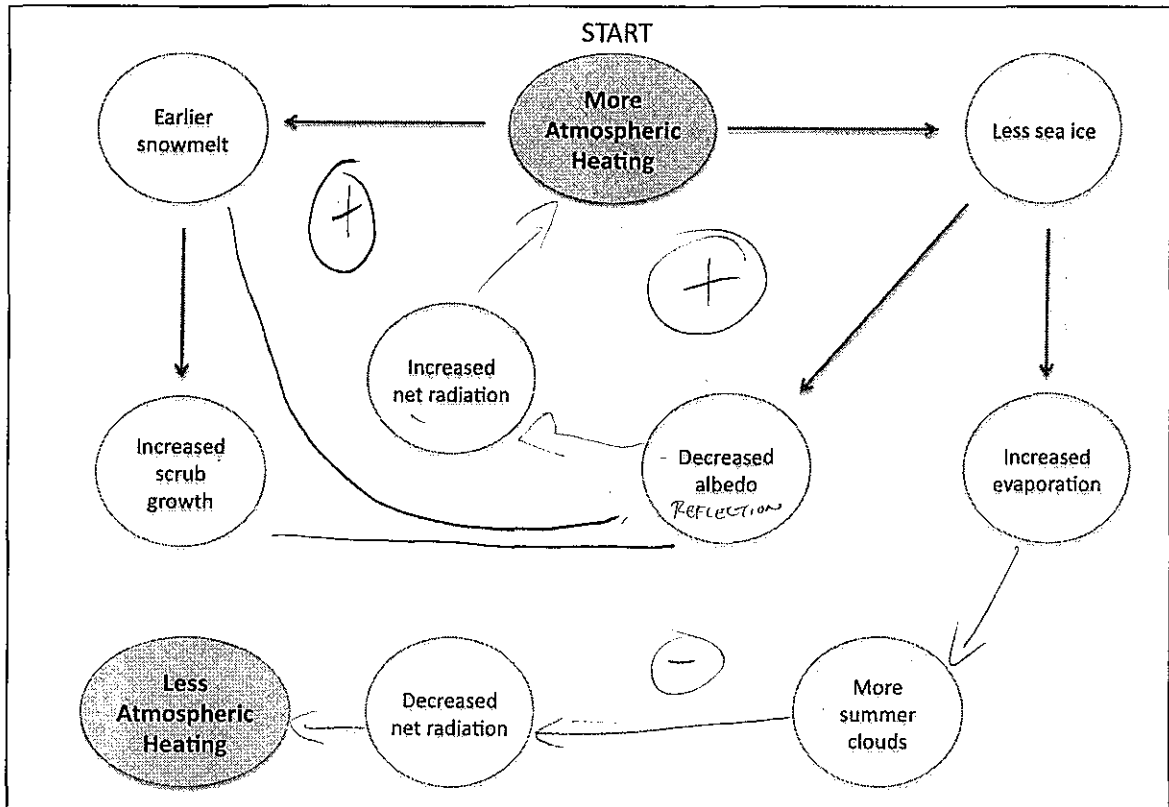
Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would be negative because usually the radiation from sun would reflect back off.

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

First there was "more atmospheric heating" which caused an "increase in sea ice" the "increased evaporation" but specific step that caused the negative feed loop was the "more summer clouds" which caused a decrease in net radiation so the heat in the atmosphere was high and due to negative feedback went in opposite direction resulting in decrease in net radiation.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

First there was "more atmospheric heating" which caused less sea ice. During times of less ice coverage more of the sun radiation gets absorbed by earth's surface & converted to thermal heat, meaning it "decreased albedo" through reflection and increase in net radiation resulting in positive feedback which is more atmospheric heating.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

a change in a system that causes more change

2. Negative feedback:

a change in a system that causes an opposite response in the system, brings closer to equilibrium

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Cloud cover blocks sunlight, slowing warming. It moves the system back, closer to an equilibrium.

B. Which specific step makes this a negative feedback loop?

decrease in temperature

C. How might cloud cover produce a positive feedback?

Clouds trap more water in atmosphere, the more water in atmosphere, the more rain and evaporation,

Albedo:

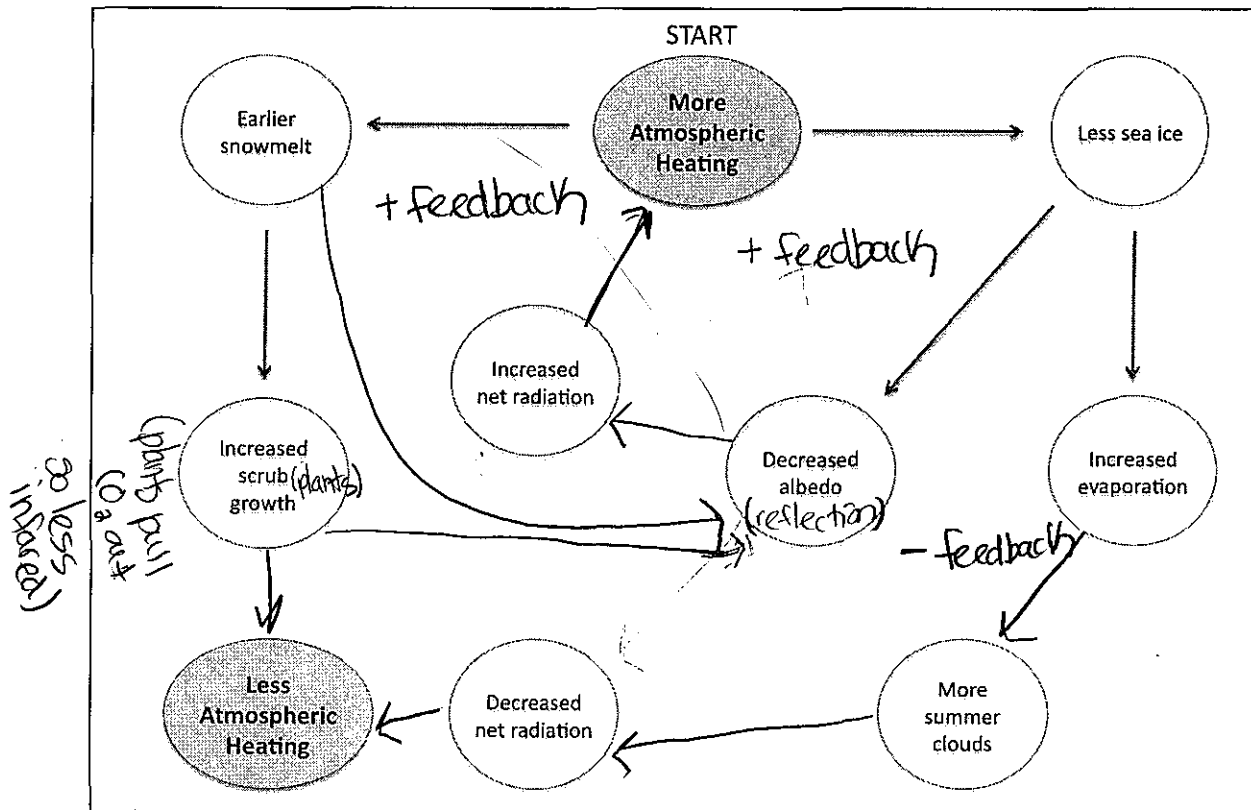
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This is a positive feedback loop. Melting of glaciers exposes more of the dark ocean water and earth surface. These absorb heat and cause more melting of the glaciers.

ISP203A – Global Change
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The negative feedback loop of a crying baby being fed brings the system closer to the equilibrium of no babies crying. If one baby stops crying, the other babies can stop or quiet down because the loud noise is gone.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

The equilibrium in a positive feedback loop of one crying baby causing other babies to cry is a silent room. The system moves from equilibrium because when one baby cries, it startles the other babies, also making them cry.

ISP203A – Global Change
Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	Greenhouse gas cause ↑ warming
Other babies wake up	warming melts permafrost and releases methane, etc.
Other babies start crying	Greenhouse gas cause ↑ warming

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover : Global warming
Babies are crying	Greenhouse gas cause ↑ warming
Nurse feeds hungry baby	warming causes evaporation and ↑ cloud cover
Hungry baby stops crying	cloud cover block sunlight, causing less warming
Other babies stop crying	

GROUP #: 21
Student IDs of Members Present:
A43535121 A36628634
A42134271 A42271052
A42052431

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: changes in a system causing further changes in the system
2. Negative feedback: changes in a system that can slow down a change or stop the change.

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

It's considered a negative feedback because they block the sunlight from reaching the earth, reflecting more light into space, decreasing earth's temperature.

- B. Which specific step makes this a negative feedback loop?

Cooler atmospheric temperatures results in less cloud development.

- C. How might cloud cover produce a positive feedback? to temperature.

It's warm, therefore causing evaporation, causing clouds, causing rain which makes it warmer.

Albedo:

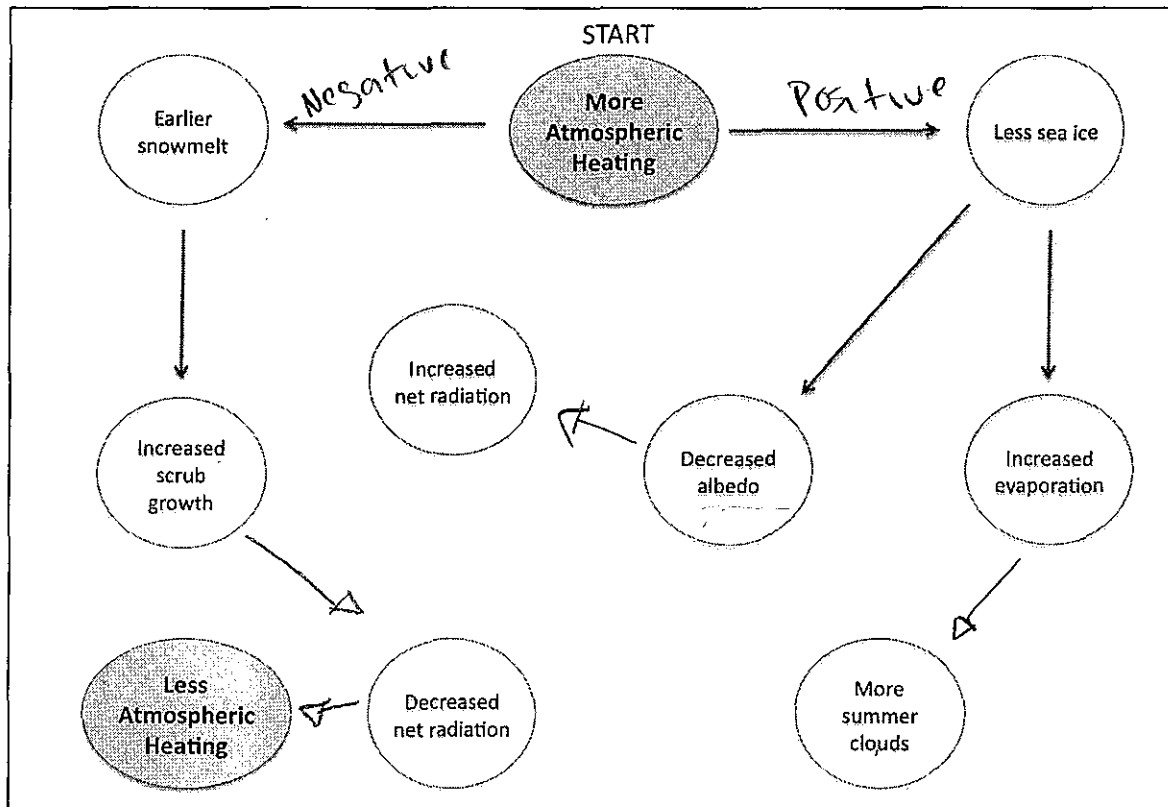
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

The melting and loss of glacial ice and ice sheets is a positive feedback system. The relationship between the extent of ice cover and the albedo of the surface of the Earth generates this feedback system. As ice recedes and melts, more solar radiation is absorbed by the surface.

21

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The negative slows down the system which brings it closer to equilibrium

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Positive means that a system continues to move away from the equilibrium.

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: speeds up the process.

2. Negative feedback: slows/stops the process.
brings it closer to equilibrium.

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

It blocks sunlight (solar radiation) from heating the Earth's atmosphere.

B. Which specific step makes this a negative feedback loop?

Blocking the solar radiation.

C. How might cloud cover produce a positive feedback?

maybe it acts ~~as a block~~ like Greenhouse gases and blocks sunlight in Earth's atmosphere. In this instance, it would create a ~~negative~~ positive feedback loop.

Albedo:

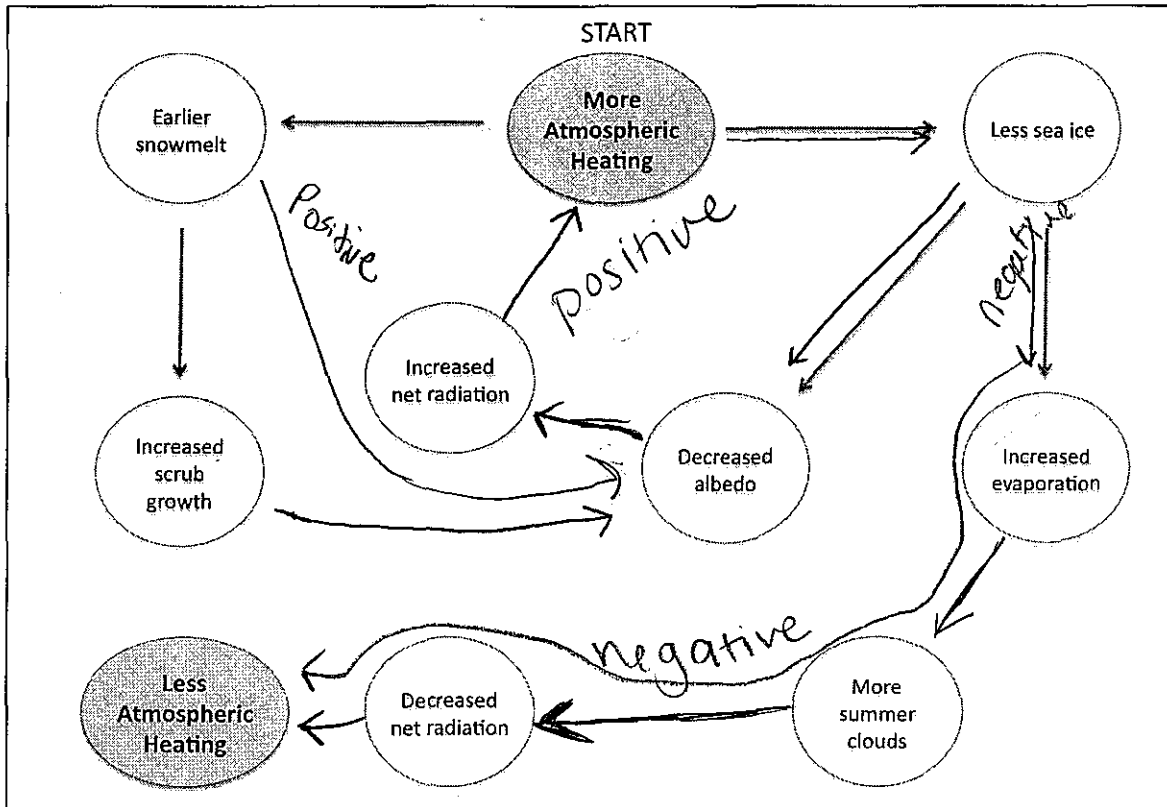
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Negative. The Albedo effect is the opposite of the Greenhouse Effect. The Albedo Effect results in global cooling because more sunlight is reflected back into space.

22

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more atmospheric heating means less sea ice. Less sea ice means more off it is water to evaporate creating more cloud to block incoming solar radiation meaning less atmospheric heating therefore slows global warming.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Albedo Effect is the process of global cooling so a decreased Albedo Effect would contribute to increased global temps & more atmospheric heating. The Less sea ice contributed to a decrease Albedo Effect because the less ice to reflect solar radiation back into space. This speeds up the process of Global Warming.

23

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	
Other babies wake up	
Other babies start crying	

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	
Nurse feeds hungry baby	
Hungry baby stops crying	
Other babies stop crying	

GROUP #: 23
Student IDs of Members Present:
A39474585
A39732455
A43050270

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

one event causes other events to happen, which causes other events.

2. Negative feedback:

one event causes another event to happen less, in order to reach equilibrium

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

greenhouse gases cause warming, but this produces more clouds, which reflect sun & decrease warming

B. Which specific step makes this a negative feedback loop?

the clouds cause an increase in cooling

C. How might cloud cover produce a positive feedback?

cloud cover causes an increase in reflection of light which causes the temperature to decrease

Albedo:

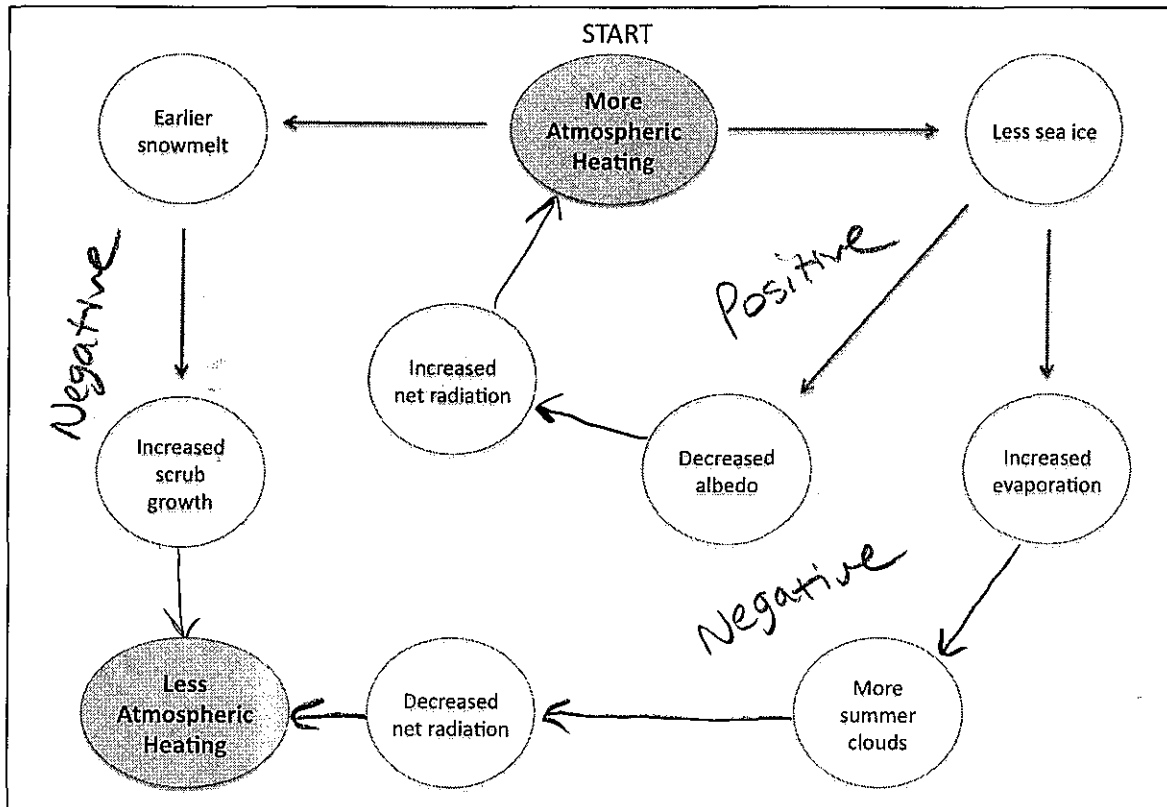
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Loss of glaciers & ice caps would result in more radiation absorbed and a positive feedback loop.

23

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More atmospheric heating creates earlier snowmelt which causes increased scrub growth

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More atmospheric heating leads to less sea ice which decreases albedo and increases net radiation

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *the change causes further change in the same direction*
2. Negative feedback: *change causes change in the opposite direction (more close to equilibrium) → slowing down, changing the rate.*

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

because cloud cover play a role of a shield. It The sunlight bounces off (reflects off) the clouds; not warming the temp.

B. Which specific step makes this a negative feedback loop?

condensation →

reflects the sunlight back into space, before it reaches the surface of the earth. Increasing clouds lets in less sunlight

C. How might cloud cover produce a positive feedback?

it could make the surface warmer.

1. *through more rain, more evaporation → increase temp.*
2. *energy releases creating more temp. increase; when releasing the temp.*

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

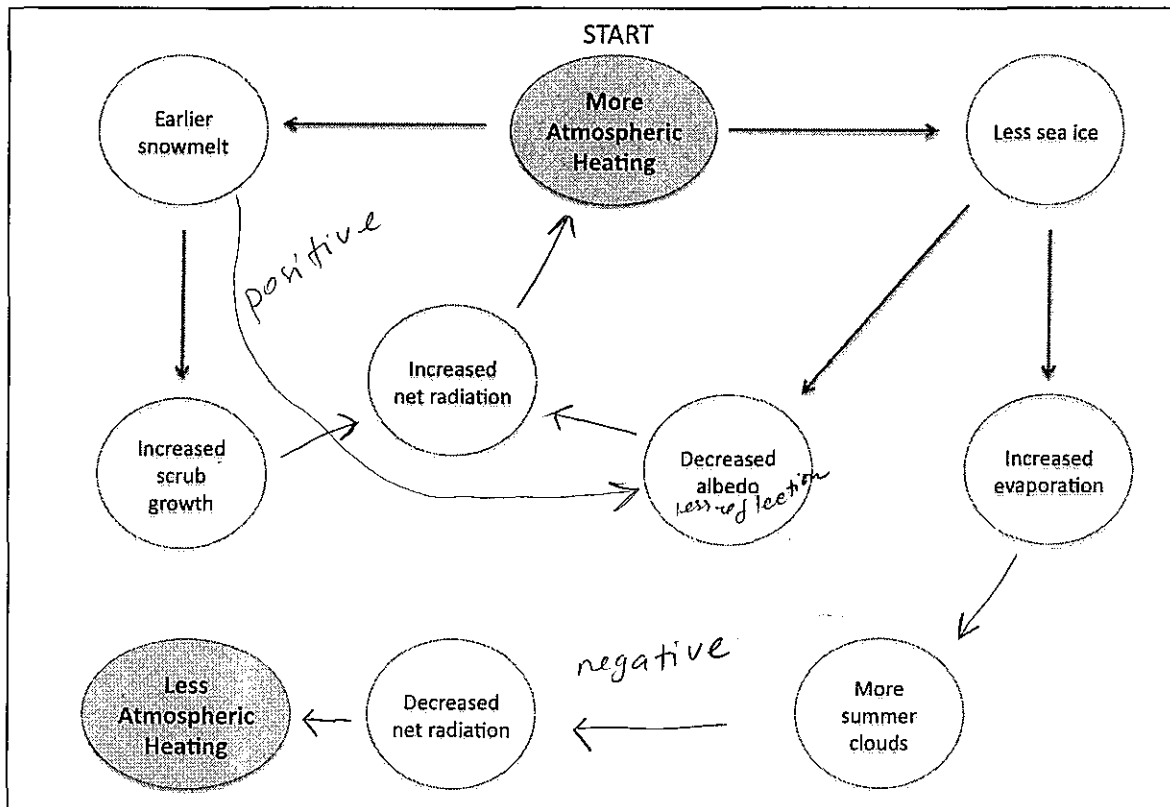
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

It would result in positive feedback loop.

Because the temperature will continue to rise w/ the more ice to melt. Warming causes loss of glaciers; loss of glaciers cause less reflection of radiation, which cause more soil to absorb the radiation, earth absorbing the radiation creates even ~~more~~ warmer climate.

24

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

The negative feedback brings the system closer to equilibrium because it slows down the process or stops the process completely to change the direction. Negative feedback creates a barrier to balance the system; instead of letting it to change completely. Evaporation causes more clouds which block the sunlight → less heating.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

Positive feedback pushes the system towards more change through change. The positive feedback increases the change in atmosphere (warming), warming causes melt, & less reflection, which causes more warming, since the earth will absorb more heat, creating the earth even warmer

ISP203A – Global Change Feedback Loops

Part 3: Homework

If you complete the group work, you may work on the homework **on your own**. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

The following mechanisms have caused the climate to change in the past.

- 1) Determine if these will cause **global warming, cooling, or neither**, and explain **why**.
- 2) Determine whether these are examples of **positive or negative feedback loops** for the climate system.

Aerosols

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

cooling

Rainforest

Cutting down large portions of the forests on Earth kills living plants that remove CO₂ from the atmosphere through respiration.

Permafrost

Melting of permafrost will release methane gas, a greenhouse gas.

GROUP #: 25
Student IDs of Members Present:
A43490816 A37626497
A43707708
A39527808 A41456018

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: Change in a system causes further changes, results in system increase overall.
2. Negative feedback: Decrease the changes going on in the system.

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

Because it causes the greenhouse process to slow down. The release of radiation would slow.

- B. Which specific step makes this a negative feedback loop?

More clouds equals less solar radiation.

- C. How might cloud cover produce a positive feedback?

could decrease the temperature of the earth.

Albedo:

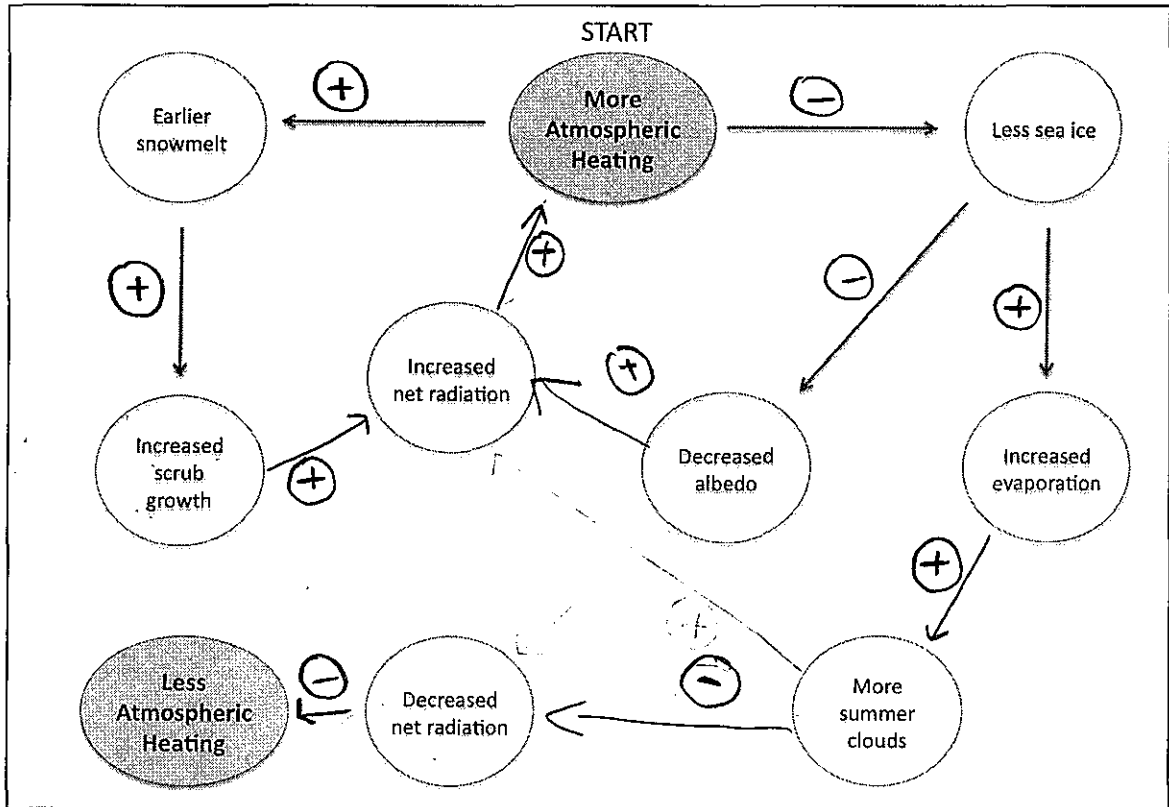
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This would be a positive feedback loop because the melting of glaciers causes other events, like the decrease of radiation reflected by the sun. This will also effect other events resulting in a positive feedback.

25

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

Because the more atmospheric ends in resulting with less atmospheric heating at the end of the loop.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

The loop always ends with more atmospheric heating and has increased with every loop instead of decreasing.

GROUP #: 28
Student IDs of Members Present:
A92707740
A42003989
A39872700

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: a change in the system causes more changes in the system so that some component changes overall neither good nor bad
2. Negative feedback: A change in the system causes an opposite change so it's closer to equilibrium. Negative feedback decreases size of changes going on in system - could also cause no change

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?
Because increased cloud cover causes weaker warming because they are letting in less sunlight

B. Which specific step makes this a negative feedback loop?
weaker warming - causing less of the same

C. How might cloud cover produce a positive feedback?
If cloud cover somehow caused an increase of clouds. — energy is released (& heat) when clouds form so temp goes up

Albedo:

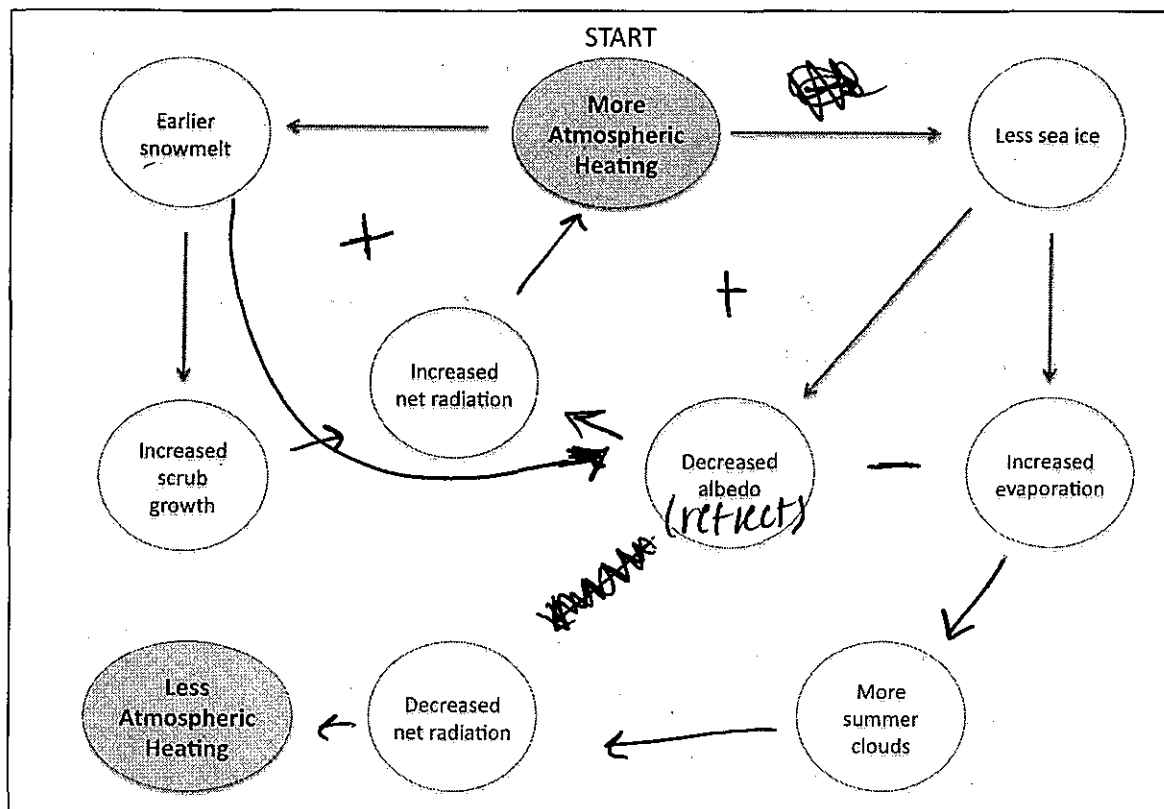
On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

positive because
increase temp → glaciers/ice melting → increased evaporation → increase temperature.

1 26

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

More heating leads to less sea ice which leads to increased evap → more summer clouds and decreased net radiation which slows the amount temperature is increasing, bringing it closer to equil.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

More heating → less sea ice → decreased albedo → increased net radiation which rises temperature even more bringing it further away⁴ from equil.

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

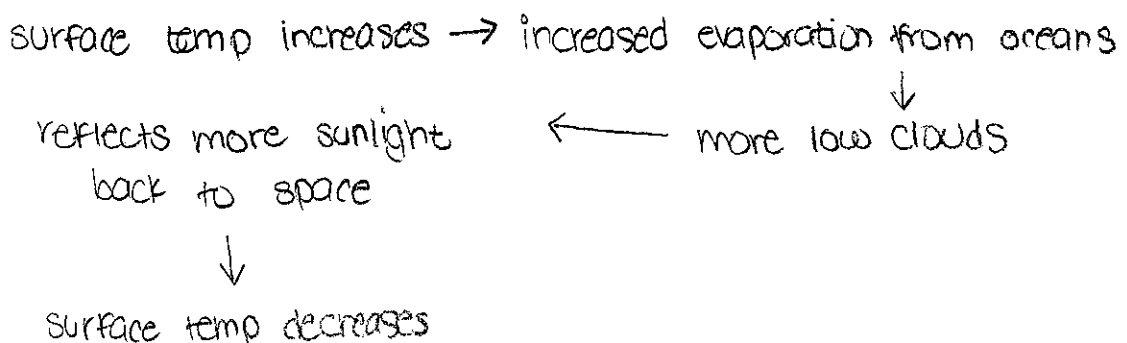
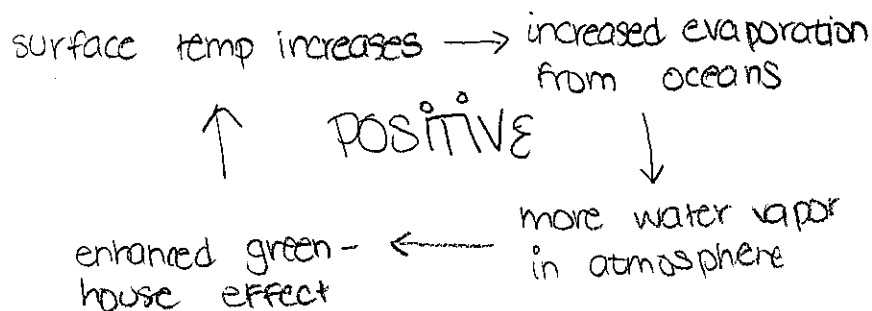
Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

positive - a change that causes overall more changes
- one component in the system increases

negative - causes an opposite response such that the system goes back to equilibrium



27

ISP203A – Global Change
Feedback Loops

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	carbon dioxide and methane are released into atmosphere
Other babies wake up	temperature increases (thaws permafrost)
Other babies start crying	more carbon dioxide and methane are released

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	increasing carbon dioxide causes increased warming
Nurse feeds hungry baby	warming causes evaporation and increased clouds
Hungry baby stops crying	more clouds = less sun
Other babies stop crying	less warming

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: A change that causes more of the same changes so that one component is increasing
2. Negative feedback: A change that causes an opposite reaction such that the system returns to equilibrium

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?

Warm temperature causes increased cloud cover however the clouds block sunlight and cause less warming

- B. Which specific step makes this a negative feedback loop?

The cooling step because this returns it to equilibrium and stops the loop

- C. How might cloud cover produce a positive feedback?

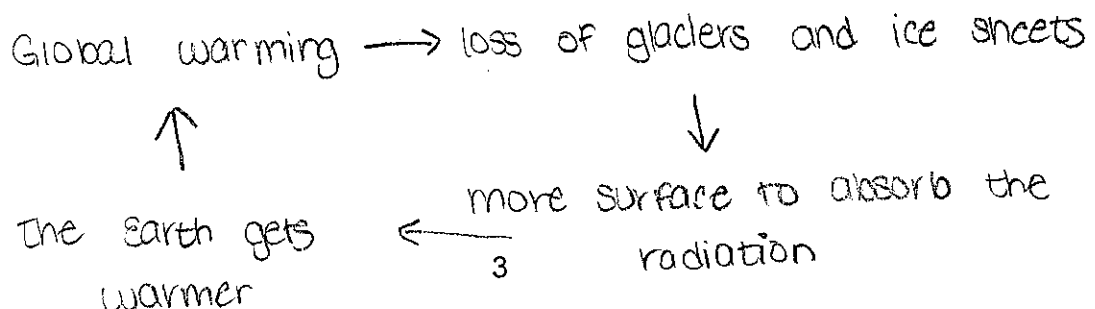
If clouds release heat (when they form), they will increase heat there would be more evaporation, more water vapor in the atmosphere, and enhance the green house effect

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

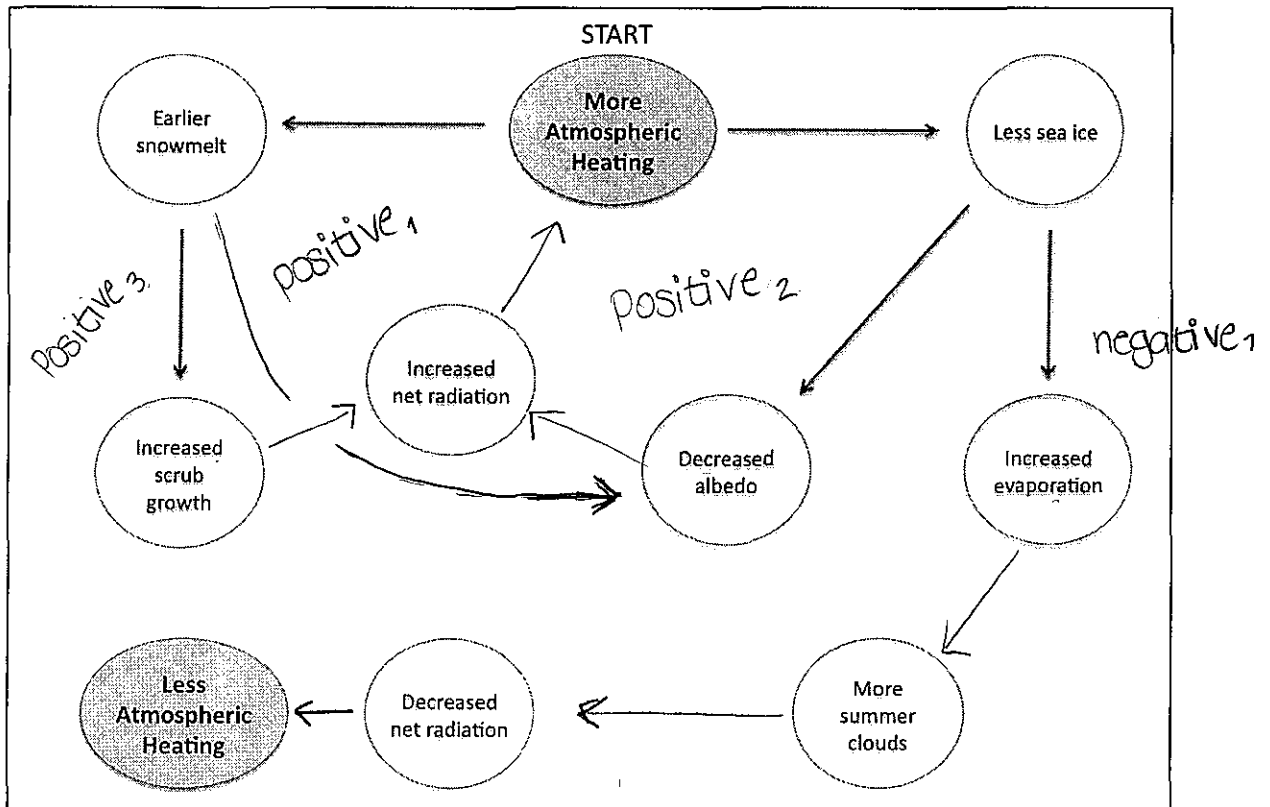
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

This results in a positive feedback loop



27

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

Initial change: more atmospheric heating > balances equilibrium
end result: less atmospheric heating

The heating and melting creates cloud coverage and decreases radiation so there is less heating

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more heat leads to more heat

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	greenhouse gas cause increased warming
Other babies wake up	warming melts permafrost & releases greenhouse gases
Other babies start crying	greenhouse gas cause increased warming

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas cause increased warming
Nurse feeds hungry baby	warming causes evaporation & increased cloud cover
Hungry baby stops crying	cloud cover blocks sunlight &
Other babies stop crying	causing less warming

GROUP #: 28

Student IDs of Members Present:
A43836396 A40678097
A41930966
A41836115

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: ✓

2. Negative feedback: ✓

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Cloud cover blocks sunlight from warming the ground & the rest of the atmosphere.

B. Which specific step makes this a negative feedback loop?

less sunlight causes weaker warming

C. How might cloud cover produce a positive feedback?

If the clouds trap the heat inside the atmosphere

• less cloud cover increase warming

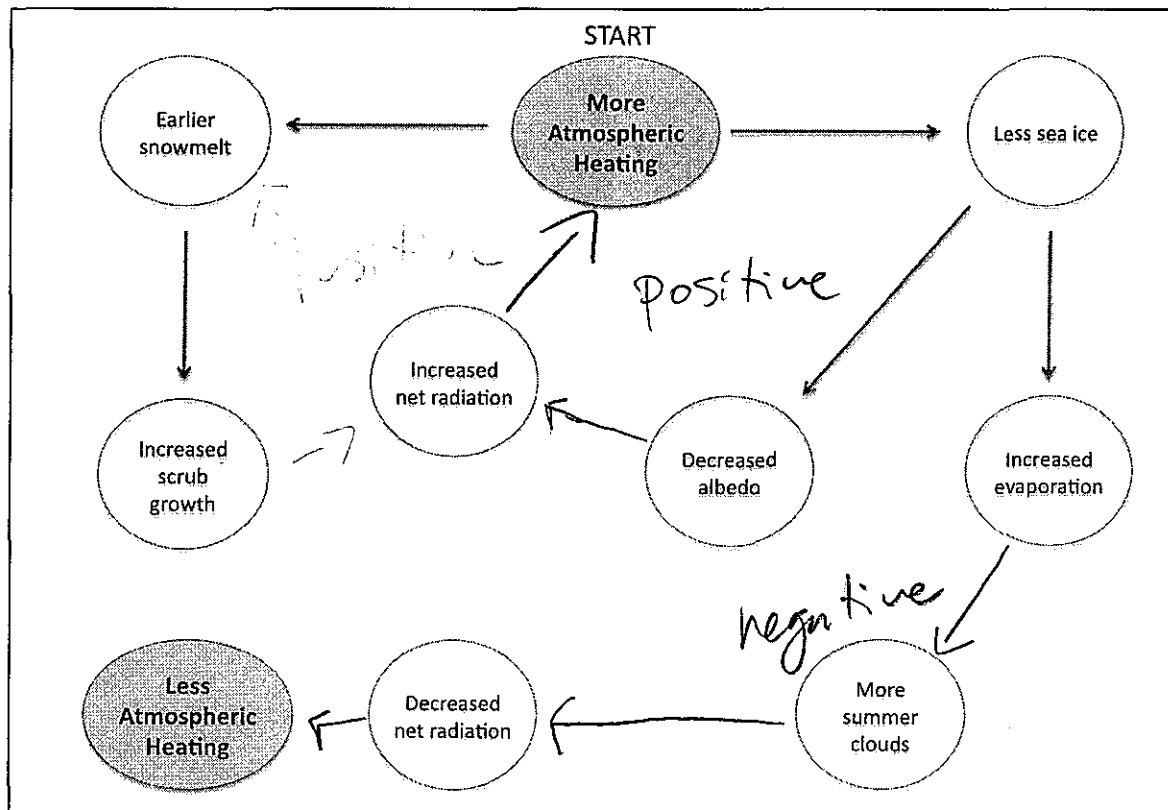
Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback, because losing glaciers & ice sheets releases thermal energy & increases the overall temperature

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

more atmospheric heating leads to less ice then more evaporation & then more summer clouds decrease radiation & cool the atmosphere bringing it closer to equilibrium

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmospheric heating leads to less ice & that leads to decreased albedo leads to increased radiation, thus warming the atmosphere and taking the system further away from equilibrium

GROUP #: 29
Student IDs of Members Present:
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A42672148
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Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback:

A change in something creates the same change

2. Negative feedback:

Change that is opposite of the other changes

Questions

A. Why is cloud cover considered a negative feedback loop in a warming climate?

Blocks sunlight and causes less warming

B. Which specific step makes this a negative feedback loop?

Increase of cloud cover

C. How might cloud cover produce a positive feedback?

Heat increases more condensation, more rain,
less clouds

Formation of clouds release heat in atmosphere

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

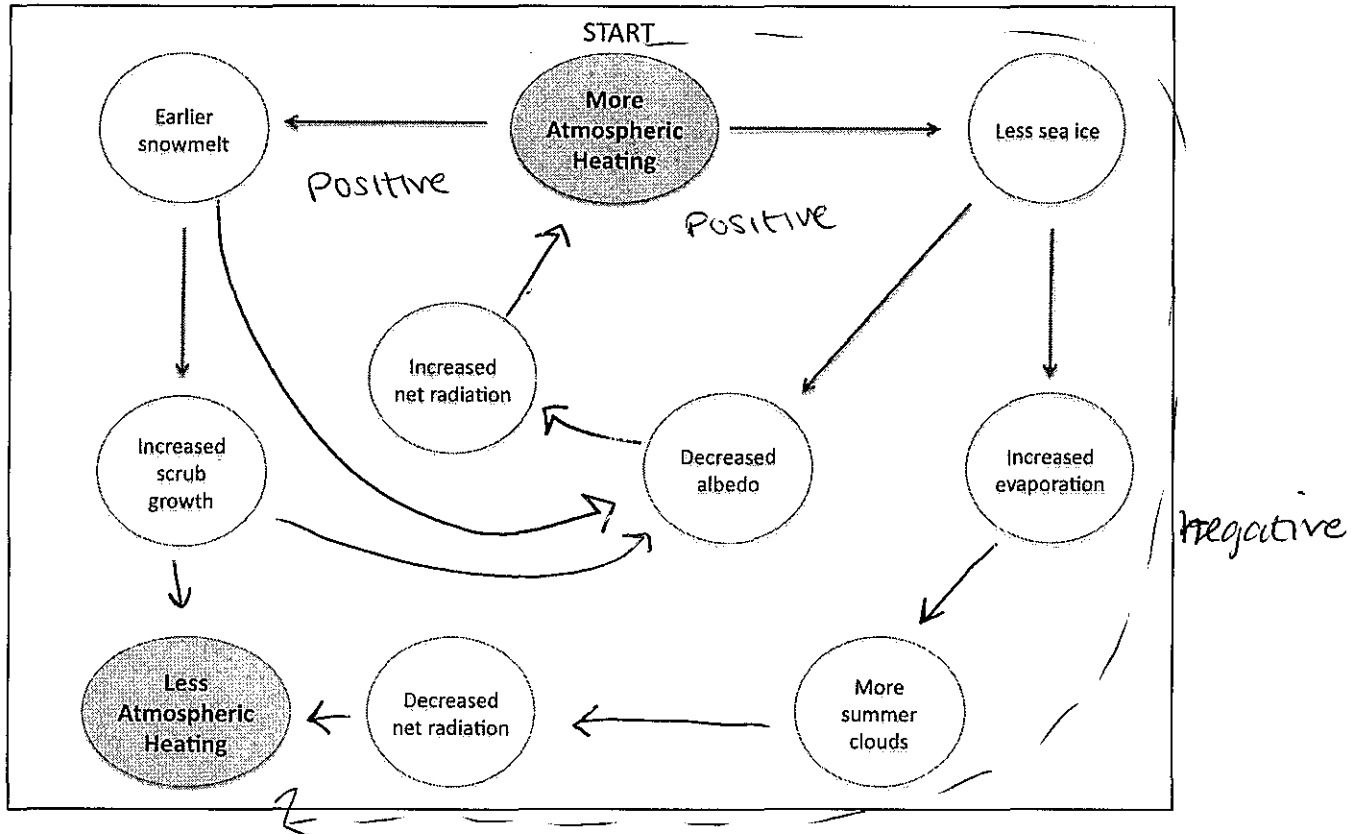
D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

Positive feedback.

Increase ~~the~~ sunlight, increase melting, increase absorbed heat

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ISP203A – Global Change
Feedback Loops

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

ISP203A – Global Change Feedback Loops

Objectives

Upon completion of this activity, you will be able to:

- Identify positive and negative feedback systems
- Describe how feedback systems impact global climate change

Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
8. **Feedback loops** can accelerate, decelerate, or dampen change.

PART 1: Background Notes

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Part 1: Class Work

The first example is a positive feedback system.

Table A. Positive Feedback Loop

Babies Crying	Permafrost in the Arctic
Baby is hungry and starts crying	greenhouse gas cause increased warming
Other babies wake up	melting of permafrost and releases methane
Other babies start crying	greenhouse gas cause warming

We will now look at a negative feedback system (Table B below.)

Table B. Negative Feedback Loop

Babies Crying	Cloud Cover
Babies are crying	greenhouse gas cause increased warming
Nurse feeds hungry baby	warming cause evaporation and cloud cover
Hungry baby stops crying	causes less warming
Other babies stop crying	reflects sun rays into outer space

GROUP #: **30**
Student IDs of Members Present:
~~XXXXXXXXXX~~ A44260728
~~XXXXXXXXXX~~ 91387561
~~XXXXXXXXXX~~ A43425519
~~XXXXXXXXXX~~ A42894705

Part 2: Group Work

Make sure everyone in your group understands these terms before moving on.

1. Positive feedback: *change in a system causes further changes in the system.*
2. Negative feedback: *change in a system that causes the opposite change*

Questions

- A. Why is cloud cover considered a negative feedback loop in a warming climate?
increasing CO₂ causes weak warming which increases clouds letting in less sunlight and making it even weaker warming.
- B. Which specific step makes this a negative feedback loop?
Low cloud coverage increases lets in less sunlight.
- C. How might cloud cover produce a positive feedback?
clouds would cause cooling

Albedo:

On Earth, water and soil covered surfaces absorb the Sun's radiation and convert it to thermal energy. Glaciers, ice sheets, and clouds reflect the Sun's radiation, rather than absorbing it. During times when Earth's surface is covered with more ice, more of the Sun's radiation gets reflected back to space. During times of less ice coverage, more of the Sun's radiation gets absorbed by the Earth's surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

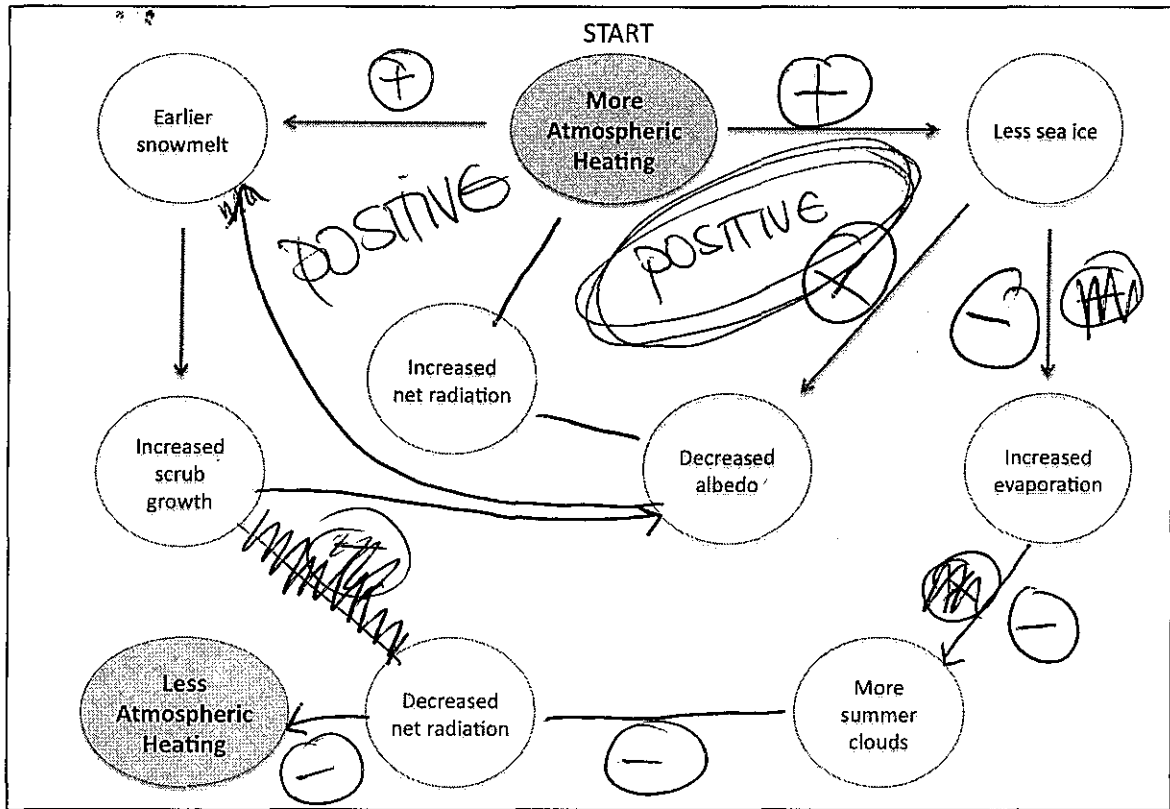
- D. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

⊕ *because the ice starts melting & causes more ice to melt*
which causes more heat to be absorbed

ISP203A – Global Change
Feedback Loops

30

On the diagram below, a) insert arrows to complete the feedback loops and b) label the feedback loops as negative and positive. MORE than one arrow may go to a single circle.



E. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

less ice \rightarrow increased evaporation - more summer clouds -
decreased net radiation - less atmospheric heating
more heating causes less heating =
equilibrium

F. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

more atmospheric heating - less sea ice -
decreased albedo - increased net radiation -
more atmospheric heating
more heating⁴ causes more
heating